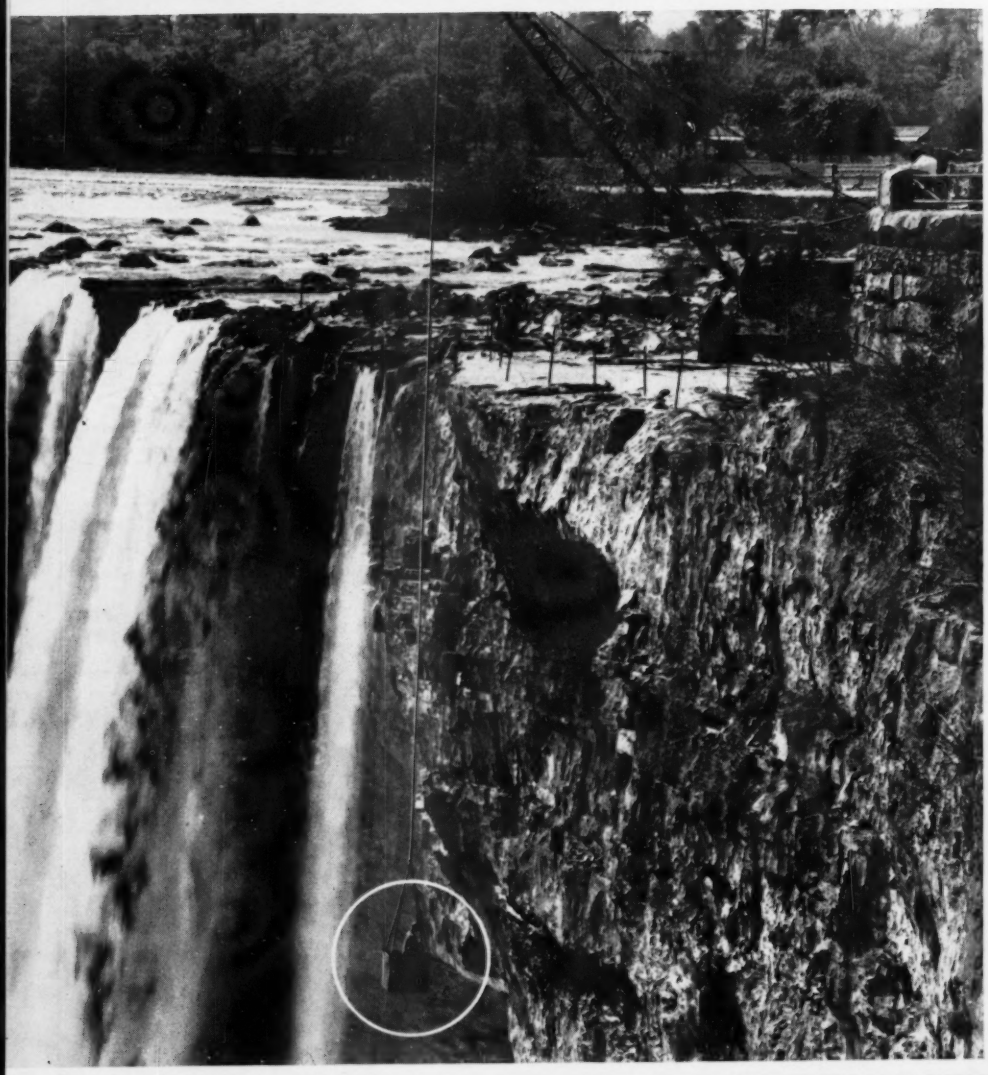
Compressed Air Magazine

SEPTEMBER 1955



GIVING NIAGARA THE ONCE OVER

A geologist suspended in a bucket inspects cliff at Horseshoe Falls

PHOTO, HYDRO-ELECTRIC POWER COMMISSION OF CANADA

VOLUME 60 • NUMBER 9

NEW YORK • LONDON

Air Casualties

It's bad air that does it. But you can step up production by putting a Coppus Blower on the job to keep the air moving — and keep the men cool.

The kind of air a man works in has a lot to do with how much work he can turn out.

In confined places like shipholds or tanks or drums or boilers . . . or wherever the air is stagnant or hot or full of fumes . . . a Coppus Blower is a *must* for getting first-class work out of the men, all the time.

A Coppus Blower or Exhauster helps avoid sickness and lassitude due to bad air . . . and improves morale, too.

Portable and adaptable for special purposes, Coppus Blowers and Exhausters will have dozens of uses around your plant. The "Blue Ribbon" (a blue painted band) is your assurance of quality performance at lowest cost.

COPPUS

BLUE RIBBON BLOWERS

THE BLOWERS THAT PUT MORE MINUTES IN EVERY MAN-HOUR

CABLE MANHOLE AND TANK VENTILATORS — BOILER MANHOLE BLOWERS AND EXHAUSTERS — HEAT KILLERS — SHIPHOLD VENTILATORS . . . DESIGNED FOR YOUR INDUSTRY — ENGINEERED FOR YOU

MAIL THIS COUPON To Coppus Engineering Corp., 209 Park Avenue, Worcester 2, Mass. Sales offices in THOMAS' REGISTER. Other "Blue Ribbon" Products in BEST'S SAFETY DIRECTORY.

PLEASE SEND ME INFORMATION ON SUPPLYING FRESH AIR TO MEN WORKING:

- ☐ in tanks, tank cars, drums, etc.
- ☐ in underground cable manholes.
- ☐ in aeroplane fusilages, wings, etc.
- ☐ on coke ovens.
- ☐ on steam-heated rubber processes.
- ☐ on boiler repair jobs.

COOLING:

- ☐ motors, generators, switchboards.
- ☐ wires and sheets.
- ☐ general man cooling.
- ☐ around cracking stills.
- ☐ exhausting welding fumes.
- ☐ stirring up stagnant air wherever men are working or material is drying.
- ☐ drying of walls, sheets, etc., after treated with coating material.

NAME .....

COMPANY .....

ADDRESS .....

CITY .....

(Write here any special ventilating problem you may have.)

Circle 1A on reply card

STAYNEW INTAKE FILTERS GIVE

GREATER EFFICIENCY

plus

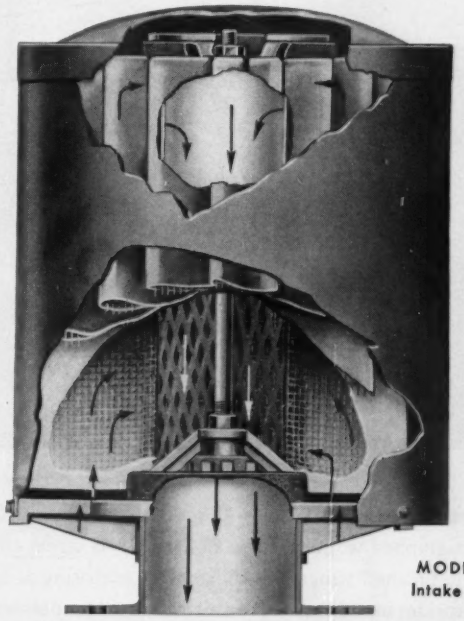
POSITIVE PROTECTION

IT'S A FACT! A filter which is 99.9% efficient is *9 times* as effective as one that is 99.0% efficient. Why?—because the filter that is 99.9% efficient lets only *one-ninth* as much dirt into the engine. And, it's the dirt that *gets in* that causes the trouble.

The extreme efficiency of Staynew Intake Filters provides *positive protection*—keeps shutdowns and repairs at an absolute minimum. Efficiency actually increases with use. Staynew Intake Filters are efficient over a wide range of loads and are not affected by temperature changes. And, Staynew Intake Filters effectively protect vital engine parts without carefully held maintenance schedules . . . frequently operating two or more *years* without attention.

Get all the facts. Write today for Bulletin S.I.F.

Representatives in Principal Cities



MODEL D
Intake Filter

DOLLINGER
PROTECTO-MOTOR
STAYNEW FILTERS

DOLLINGER CORPORATION

7 Centre Park, Rochester 3, N. Y.

ALL TYPES OF FILTERS FOR EVERY INDUSTRIAL NEED

Circle 2A on reply card

Wire Rope at Work—Probably many residents of Spokane, Wash., remember scenes like the one above, photographed while the new Coliseum was under construction. Now those curved steel beams support the roof of the finished structure, whose main enclosure is approximately 210 ft long by 125 ft wide. The largest civic auditorium in the Pacific Northwest, the Coliseum can be used for stage and trade shows, conventions, ice-skating, basketball, boxing, and other indoor activities.

Bethlehem wire rope, flexible and strong, was active during the building. Its chief job, of course, was the lifting of heavy loads, including the many roof beams. This it took in stride, performing reliably as always, and helping the steel-erection work to progress with unusual speed. A typical assignment for Bethlehem rope, which is at home on any type of construction project, large or small.

Bethlehem Steel Company, Bethlehem, Pa. On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. *Export Distributor:* Bethlehem Steel Export Corporation

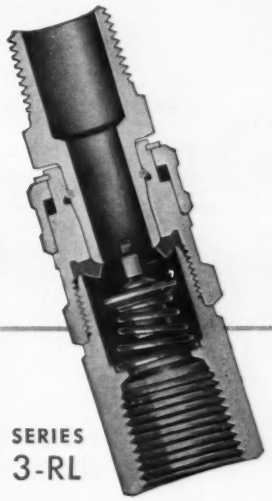
Mill depots and distributors from coast to coast stock Bethlehem rope for the following industries and numerous others:

CONSTRUCTION • MINING • PETROLEUM • EXCAVATING • QUARRYING • LOGGING • MANUFACTURING

←Circle 3A

Everything You Want

in a Quick-Connective Pneumatic Coupling



HANSEN SERIES 3-RL

RING-LOCK COUPLING

Compactly designed, the Hansen Series 3-RL Coupling *effectively* handles far more volume than any coupling of equal dimensions. On any job requiring ¾" to ⅛" connections–from the air line to the air tool—this single size Hansen Ring-Lock Coupling—with completely interchangeable Sockets and Plugs—does it all—makes it easy to keep stock of parts in balance—holds inventories to a minimum.

To connect the Series 3-RL Coupling, you merely push the Plug into the Socket. To disconnect, just turn the sleeve. When Coupling is connected, a locking ring in Socket enters groove in Plug, provides positive lock and insures tight fit. Sockets with aluminum bodies are available for use with small hand-operated air tools.

- Smaller.
- Lighter.
- Effectively handles more volume than any other coupling of equal dimensions.
- Handles any job with fittings from ¾" to ⅛", from the air line to the air tool.
- All Series 3-RL Sockets and Plugs are interchangeable—reduces stock inventory to a minimum.
- One-way shut-off—for pneumatic service applications.
- Positive locking.
- Equipped with automatic sleeve lock.

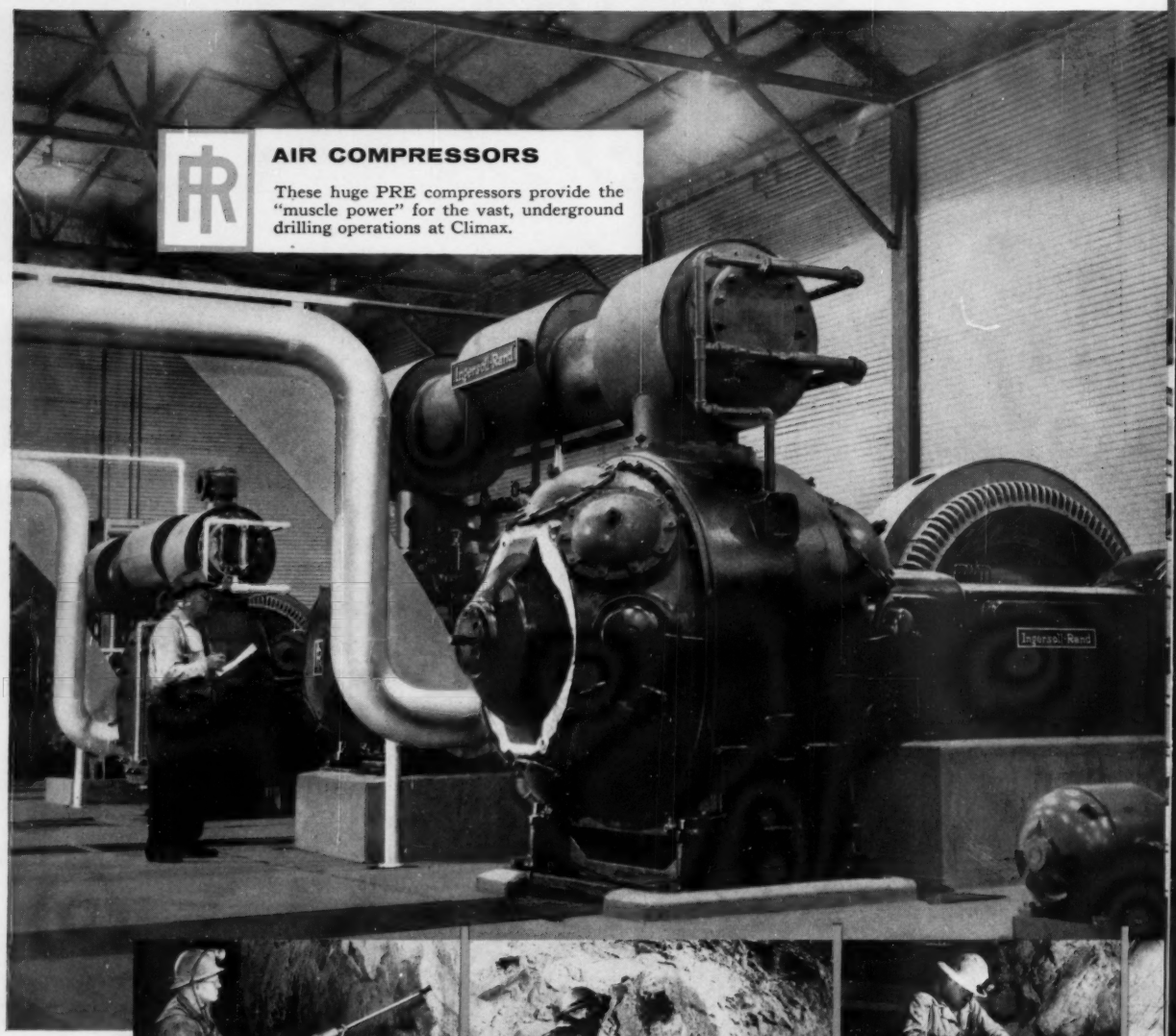
Write for Descriptive Literature

THE HANSEN MANUFACTURING COMPANY

4031 WEST 150th STREET • CLEVELAND 11, OHIO

←*Circle 3A on reply card*

Circle 4A on reply card



AIR COMPRESSORS

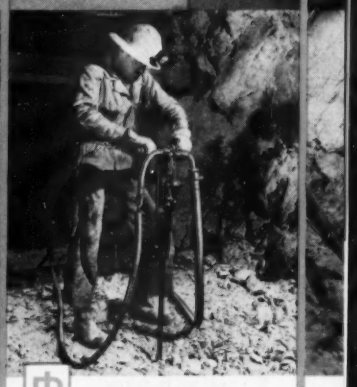
These huge PRE compressors provide the "muscle power" for the vast, underground drilling operations at Climax.

JACKDRILLS

Versatile, light-weight JR-38 Jackdrills save setup time and permit quick spotting of holes for drilling in practically any position.

STOPEHAMERS

These husky, hard-hitting stopers maintain consistently high drilling speed for all types of up-hole work.



JACKHAMERS

For down-hole and secondary drilling, the easy-handling J-40 Jackhamer is a big saver of time and effort.

Everything you need for drilling rock—from the compressor

DRILLING POWER AT Climax

North America's largest underground mine maintains top efficiency with I-R equipment

It takes plenty of *drilling power* to mine 8½ million tons of molybdenum ore per year. And to achieve this annual production on a profitable basis requires top efficiency of all equipment, from the cutting face all the way back to the compressor station.

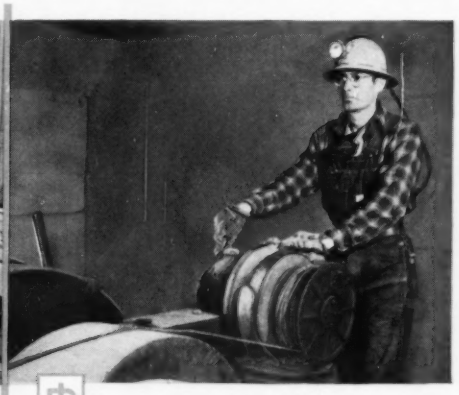
That's why we at Ingersoll-Rand take pride in the vital role which I-R equipment has played in the successful operation of Climax Molybdenum Company's huge Climax mine. Here I-R rock drills, Carset Jackbits, air compressors, air hoists, bit shop equipment and centrifugal pumps helped to turn out 73% of all molybdenum produced by the free world in 1954.

CARSET JACKBITS

Carsets have become the standard of drilling speed and economy at Climax — because they maintain their high cutting efficiency for hundreds of feet of hole.

BIT SHOP EQUIPMENT

Cut-off machines, drill steel furnaces, sharpeners and draw furnaces keep drill steels in shape for top performance.



AIR HOISTS

These powerful utility hoists are widely used for hauling ore cars up grade and operating scraper equipment.

14-270

to the Carset Jackbit

Ingersoll-Rand

11 BROADWAY, NEW YORK 4, N. Y.

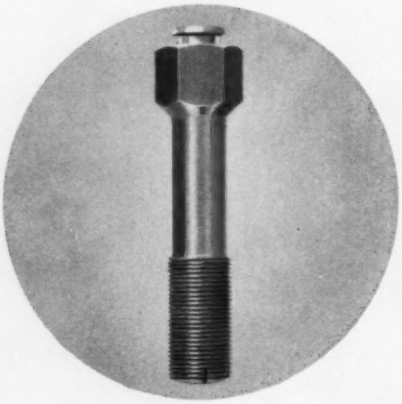
LUBRICATE PLUG VALVES

in seconds— instead of minutes

with this timesaving combination

Yes, seconds are all it takes to lubricate plug valves, today. You'll eliminate waste, and save time and effort with this combination: Walworth High Pressure Lubricant Gun, Walworth Button-Head Fittings, and Walworth Jumbo Size Lubricant Sticks. They'll pay for themselves quickly and are adaptable to most of the lubricated plug valves that are in use today.

Walworth High Pressure Lubricant Gun. This is the only gun available today that satisfactorily handles the stick form, full-bodied lubricants needed for proper lubrication and sealing of plug valves. Easy to operate; two Jumbo Size Lubricant Sticks fill the barrel.



Walworth Button-Head Lubricant Fittings. Use them as lubricant fittings or as regular lubricant screws with standard size lubricant sticks. Just slip hose coupling onto fitting for a leakproof connection.

Walworth Jumbo Size Lubricant Sticks. Individually wrapped and packed ten to the box; clean and easy to handle . . . eliminate messy loading. Types available for most line fluids. Always use Walworth Lubricants in Walworth Lubricated Plug Valves.

Start saving today . . . call your nearby Walworth Distributor. He'll be glad to supply Walworth High Pressure Lubricant Guns, Button-Head Fittings, and the right Jumbo Size Lubricant Sticks for any lubricated plug valve service condition.

WALWORTH

Manufacturers since 1842

valves . . . pipe fittings . . . pipe wrenches

60 East 42nd Street, New York 17, N. Y.

DISTRIBUTORS IN PRINCIPAL CENTERS THROUGHOUT THE WORLD

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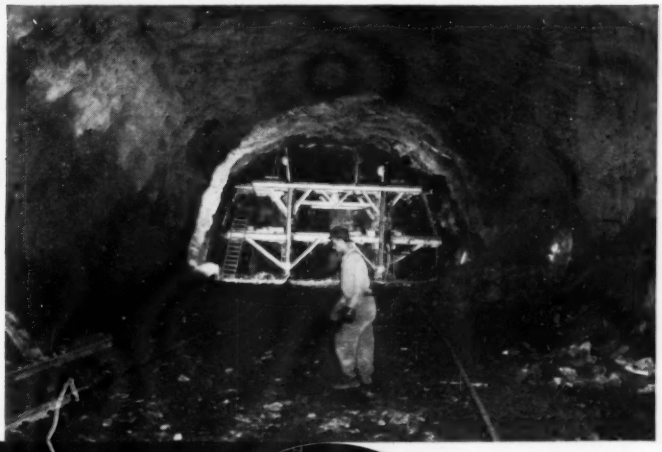
Part way through the 705 foot rock section on the New Jersey side.



THEY'RE AVERAGING 630-FEET PER ROD

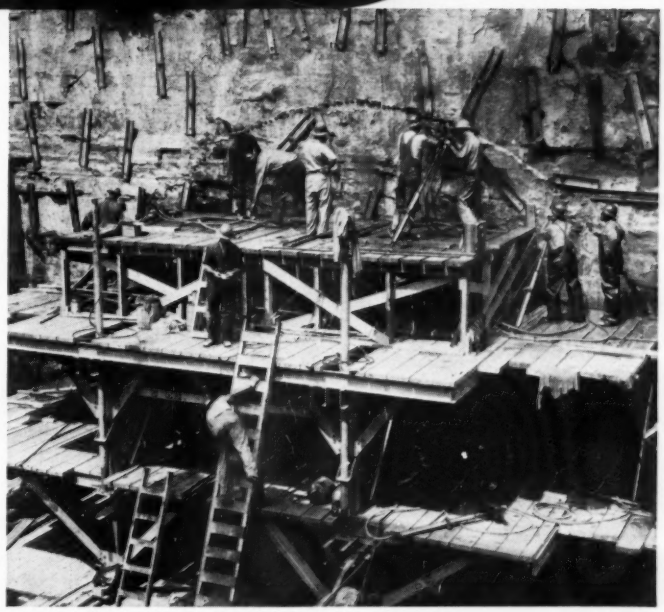
with

CRUCIBLE alloy hollow drill steel...

When completed the third tube of the Lincoln Tunnel will speed vehicular traffic between New York and New Jersey under the Hudson River.

On the New Jersey side construction involves tunneling through 705 feet of rock, and moving 24,000 cubic yards of trap-rock and sandstone. For this big job the contractors, Mason Johnson MacLean, chose Crucible CA Double Diamond alloy hollow drill rods. It proved to be an excellent choice, for in drilling 108,500 feet of hole, Crucible alloy drill rods gave an average of *630-feet per rod*.

There's good reason for this *extra* performance. For Crucible alloy hollow drill rods are made to *tool steel standards*, by the nation's leading producer of tool and other special purpose steels. You can count on longer rod life . . . fewer broken rods . . . *lowest cost per foot of hole drilled* . . . when you specify Crucible alloy hollow drill rods. *Crucible Steel Company of America, Henry W. Oliver Building, Pittsburgh 22, Pa.*



Drilling starts on the third tube of the Lincoln Tunnel.

CRUCIBLE first name in special purpose steels

Crucible Steel Company of America

Circle 7A on reply card

Adjustable-speed Gýrol Fluid Drive

controls the flow in catalytic reforming processes

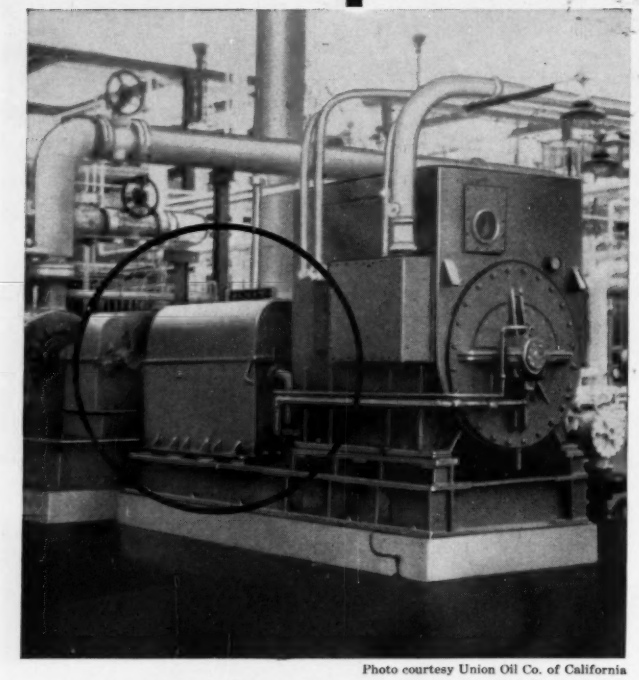


Photo courtesy Union Oil Co. of California

Unit shown is a 4000 hp, 1800 rpm, size 315, type VS, Class-6 Gýrol Fluid Drive equipped to automatically regulate the speed of a centrifugal compressor handling variable-density gases.

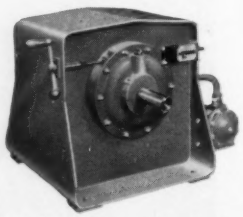
Accurate control of the flow of gases and fluids is the key to the successful operation of a catalytic reforming plant. Because its speed is *adjustable*, American Blower Gýrol Fluid Drives can vary the flow rates of compressors and pumps of all sizes and types — *as needed*. Consider these inherent advantages of Gýrol Fluid Drive:

- Provides infinite and accurate pump speed adjustment over a wide range
- Simplifies starting equipment — provides no-load starting
- Eliminates problem of "gumming" which may occur with mechanical dampering
- Saves steam needed for process work through use of squirrel-cage, constant-speed electric motor
- Permits automatic control. Flow rates can be automatically regulated by simple movement of one push-pull control rod

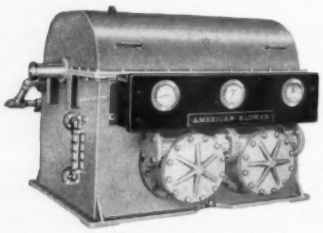
Whatever your method of catalytic reforming, use Gýrol Fluid Drives for flow-rate control. Call your nearest American Blower Branch Office for data.

Traction-type Fluid Drives

American Blower Type TM, traction-type fluid drives are also available as complete packaged units containing AC motor and built-in Gýrol Fluid Drive. Standard NEMA mounting bolt hole dimensions. 1 to 20 h.p.



Type VS, Class-2, adjustable-speed Gýrol Fluid Drive. Speed range: 5 to 1. Six sizes, 7½ to 800 hp; speeds to 1800 rpm.



Type VS, Class-6, Gýrol Fluid Drive. Adjustable-speed drive for compressors, pumps, and other high-speed applications. 200 to 12,000 hp; to 3600 rpm.

American Blower products serve the petroleum industry

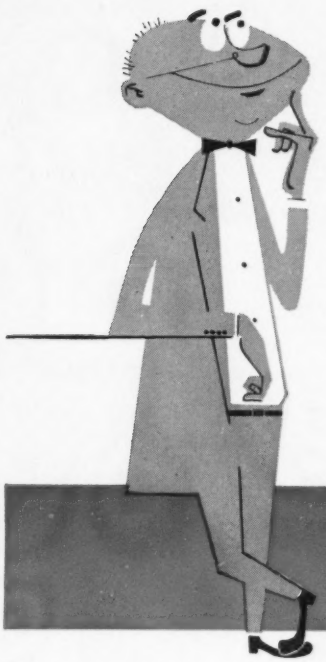
- Air Conditioning, Heating, Ventilating Equipment
- Mechanical Draft Equipment
- Industrial Fans and Blowers
- Centrifugal Compressors
- Gýrol Fluid Drives

AMERICAN BLOWER CORPORATION, DETROIT 32, MICHIGAN
CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO
Division of American Radiator & Standard Sanitary Corporation

AMERICAN BLOWER

Serving home and industry: AMERICAN-STANDARD • AMERICAN BLOWER • CHURCH SEATS & WALL TILE • DETROIT CONTROLS • KEWANEE BOILERS • ROSS EXCHANGERS • SUNBEAM AIR CONDITIONERS

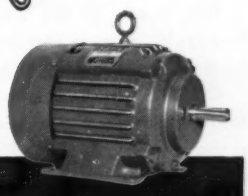
BEARING TROUBLES?



NO SIR! Not with new Reliance Motors and METERMATIC .... the

Automatic Grease Monkey

I found out how to put an end to burned out bearings from the Reliance Metermatic Bulletin, A-2406. Why don't you write for one? A-1499



RELIANCE ELECTRIC AND ENGINEERING CO.

Cleveland 10, Ohio • Offices in Principal Cities

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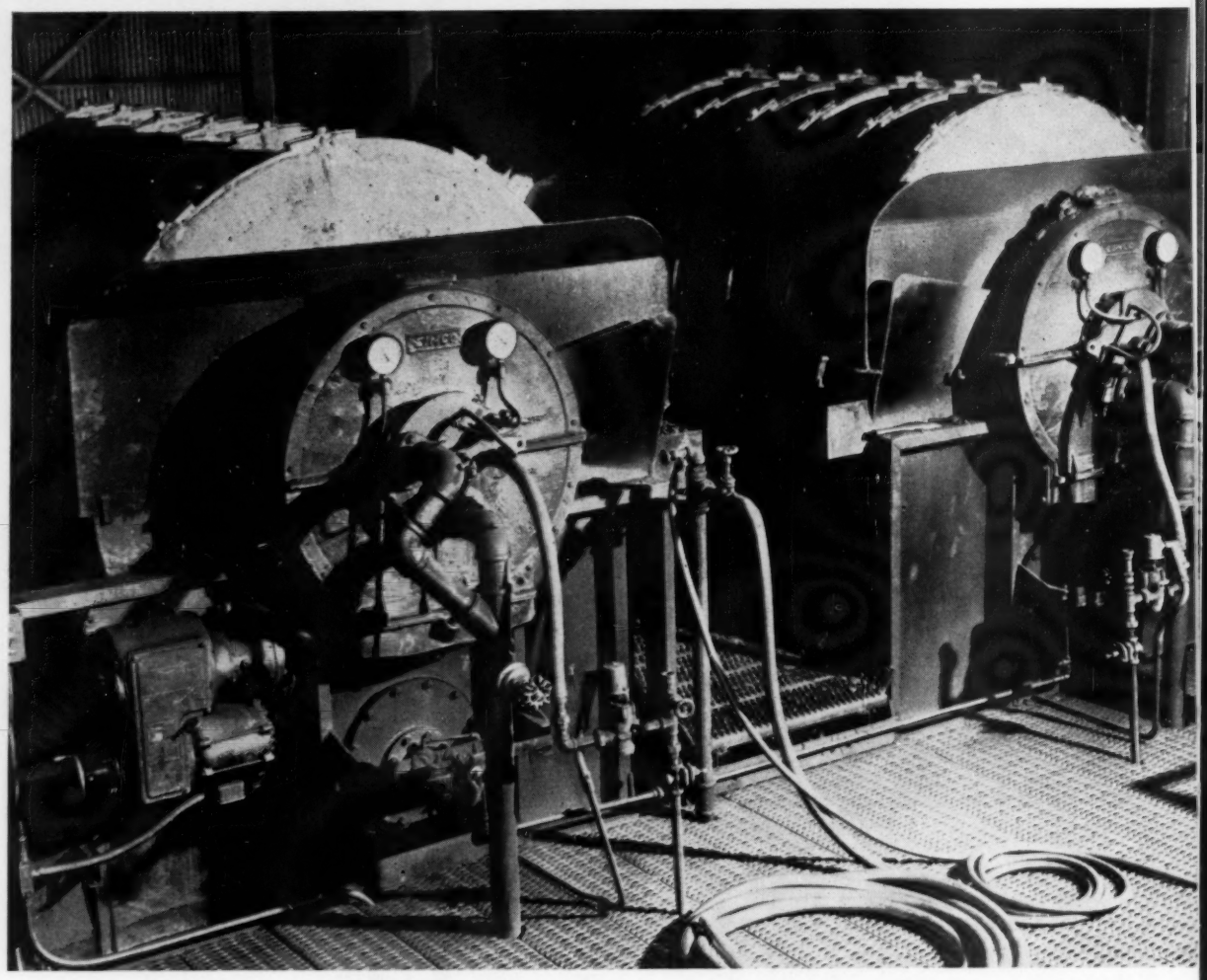


REDUCE COSTS AND

Eimco equipment helps to reduce costs and increase production at Climax Molybdenum Company property at Climax, Colorado.

This is one of the world's great mines, more than two miles above sea level and with the record for high tonnage production on a per man shift basis.

One of the pieces of equipment used to obtain high tonnage production is the Eimco Folding Scraper. This scraper was developed at Climax by Climax people and its use permits loading ore into cars at a rate of 16 tons per minute from one slusher drift.

In the development headings, dependable Eimco air-powered 12B, 21 and 40H RockerShovels load out the broken material to keep development on schedule.

Along the main haulage ways, especially at loading stations, cleanup is maintained by a trolley type electric powered Eimco 40HE RockerShovel. This loader has a power swing to clean the full width of the drift and the trolley permits it to transport itself quickly around the mine.

In the mill, Utaloy liners are among the brands

EIMCO BRANCH OFFICES AND AFFILIATED COMPANIES

New York, N. Y. Chicago, Ill. San Francisco, Calif. El Paso, Tex. Birmingham, Ala. Duluth, Minn. Kellogg, Ida. Baltimore, Md. Pittsburgh, Pa. Seattle, Wash. Pasadena, Calif. Houston, Texas Vancouver, B. C. London, England Gateshead, England Paris, France Milan, Italy Johannesburg, South Africa

INCREASE PRODUCTION

employed as mill linings. Utaloy liners are molybdenum — chrome alloy steel, carefully heat treated. Marquenching in molten salt assures uniform hardness throughout liner sections up to 8 inches in thickness.

Eimco Agidisc filters are at work dewatering the concentrate in the mill. This recent installation handles 350,000 lbs. of concentrate per 24 hour day. The Eimco filters operate automatically and require only periodical inspection. They require less than 50% of the floor space used for the equipment they replaced, have reduced the moisture content in the cake by 33%, and increased the filter rate by more than 15%.

Eimco equipment will help to increase production and reduce costs in your mine and mill. Specialized equipment to meet your requirements in loading or filtration has been developed to meet the needs of industry. Call an Eimco engineer to help you specify the equipment best suited for your job. There is no obligation.

THE EIMCO CORPORATION

Salt Lake City, Utah—U.S.A. • Export Offices: Eimco Bldg., 52 South St., New York City

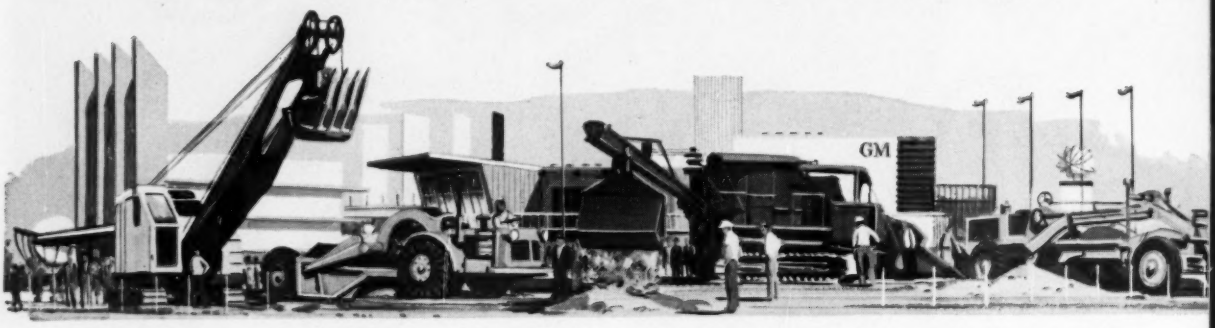
B-134

A Show you'll never forget!

GENERAL MOTORS POWERAMA

Gala Celebration of the 100 Millionth GM Diesel

LAKE SHORE SOUTH, CHICAGO—AUG. 31ST THROUGH SEPT. 25TH



GM Powerama presents—"roads a-building" exhibit of GM Diesel-powered equipment for both concrete and asphalt highway construction—dump trucks, concrete paver, rock crusher, graders, rollers and scrapers.

MAKE your plans now! The General Motors Powerama will be a national event too important, too spectacular to miss.

On 20 acres of grounds, a World's Fair of Power will unfold wonders galore. Fascinating exhibits—thrilling demonstrations—a colorful stage show—everything to make your visit interesting, educational and well worth the trip.

Come and bring the family. *Admission free!*

Plus many other interesting exhibits you won't want to miss—

ALLISON TURBO-JET and TURBO-PROP engines that power America's finest, fastest fighters and transports.

CLEVELAND DIESEL engines powering a submarine you can go aboard and inspect.

ELECTRO-MOTIVE's advanced lightweight 100-mile-an-hour train with its amazing new air-suspension springing.

EUCLID's full line of 10- to 50-ton Diesel trucks and 7-to 18-yd. scrapers.

FABRICAST's exhibit of modern casting methods.

GMC Diesel trucks and coaches, SceniCruiser and spectacular new "L'Universelle."

And a Complete Exhibition of GM's 7 Dazzling Dream Cars:

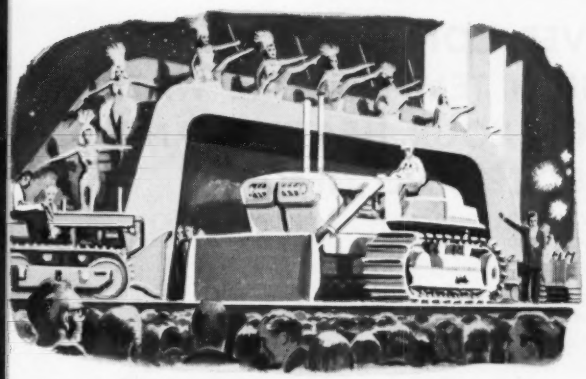
CHEVROLET BISCAYNE • PONTIAC STRATO STAR • OLDSMOBILE "88" DELTA • BUICK WILDCAT III • CADILLAC ELDORADO BROUGHAM LA SALLE II SEDAN • LA SALLE II SPORTS CAR

GM GENERAL MOTORS DIESEL POWER

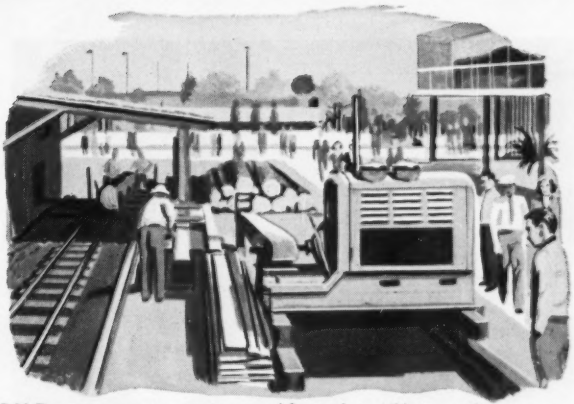
DETROIT DIESEL ENGINE DIVISION

GENERAL MOTORS • DETROIT 28, MICHIGAN

In Canada: General Motors Diesel, Ltd., London, Ontario



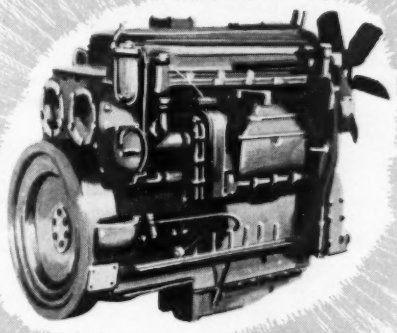
GM Powerama presents—"More Power To You"—a mammoth variety show in which Diesel-powered vehicles perform fantastic maneuvers—with Big Top circus acts and a huge cast of dazzling dancing starlets.

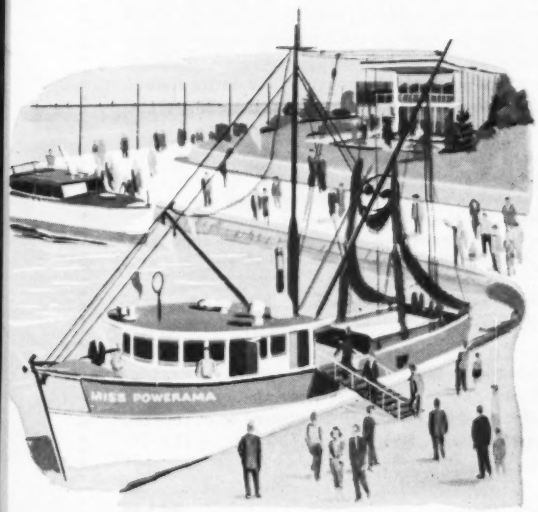


GM Powerama presents—a wide variety of interesting, *operating* exhibits showing the use of Diesel power in many fields including a sawmill, a cotton gin, an irrigation system, a farm tractor and a feed mill.

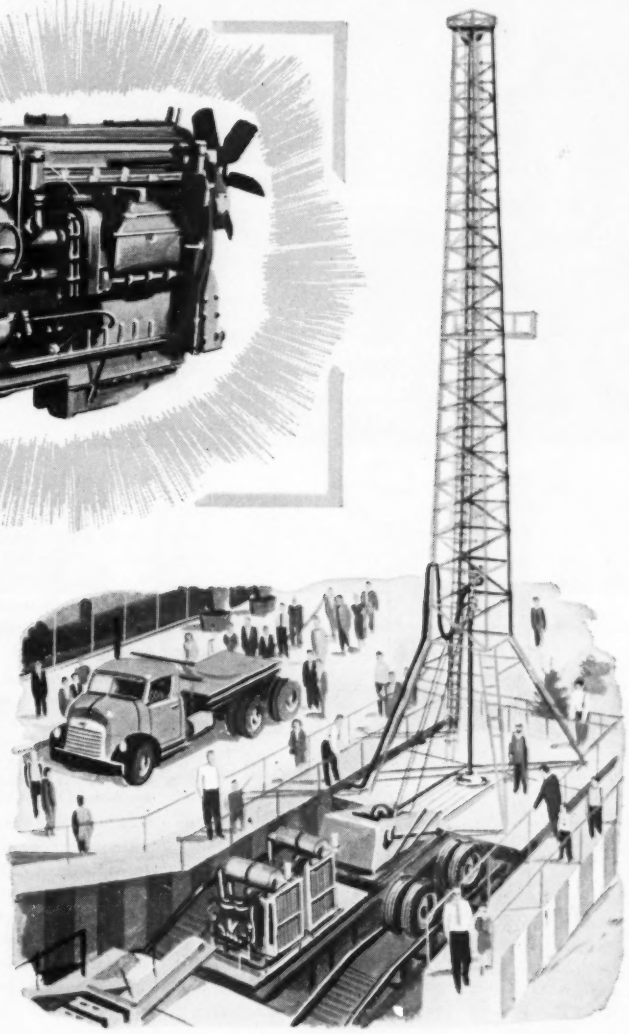
Horsepower

GM Powerama presents—at the head of the parade—Detroit Diesel's golden "6-71" Diesel engine (representing 100 Millionth General Motors Diesel H.P.). Also, Dr. Diesel's first engine and exhibits ranging from the 1933 World's Fair Diesel engine to the compact new "51" engine that opens new fields for Diesel usefulness.

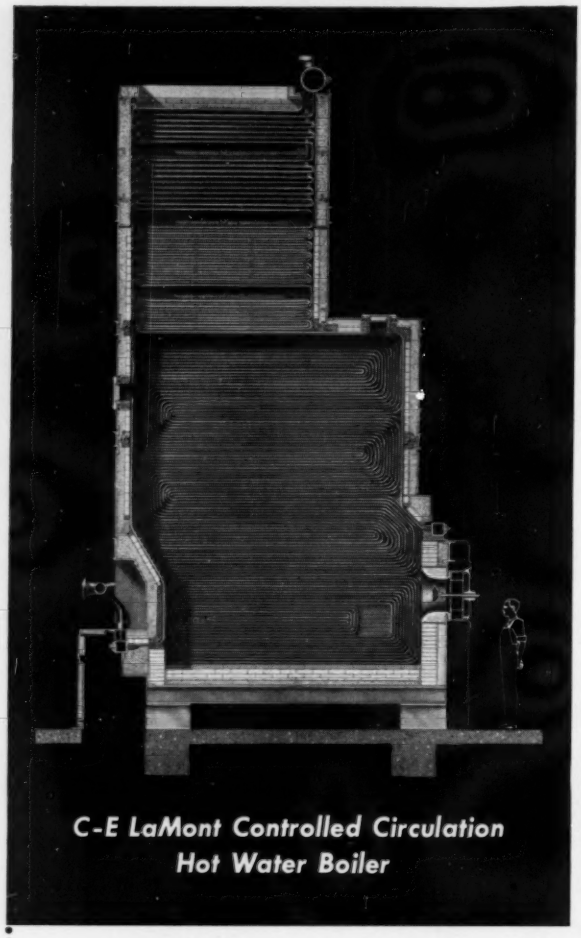




GM Powerama presents—a marine display including GM Diesel-powered shrimp boat and 36-foot and 22-foot pleasure craft for the interest of those who want Diesel safety, speed and economy in their boats.



GM Powerama presents—a modern, portable oil-well drilling rig in action, powered by General Motors 2-cycle Diesel engines which have won a reputation for "more power in less space with less weight."



C-E LaMont Controlled Circulation Hot Water Boiler

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Both steam and high temperature water have their place, and your particular requirements will determine which is best for you. In either case the complete C-E line includes a type and size of boiler exactly suited to your requirements. Where high temperature (HT) water seems indicated, it affords such important advantages as:

1. The higher available heat in HT water... many times that of steam at the same pressure.
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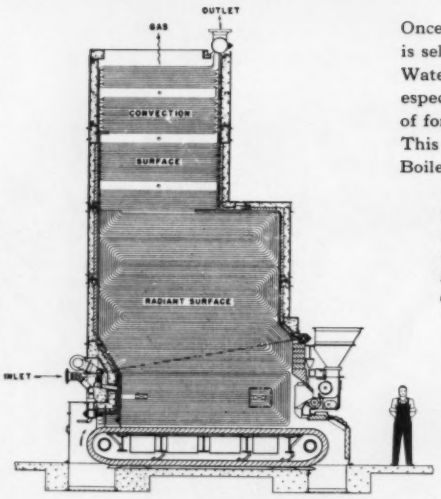
3. Heat loss is minor with the HT water closed system . . . no condensate losses... unused heat returns to the boiler.
4. No elaborate feedwater treatment required because make-up requirements are small.
5. No steam traps are needed, which means elimination of all trap problems and attendant expense.
6. No blowdown losses... no safety valve vent losses... no condensate return lines.

The planning of any new heating and/or processing system should give proper consideration to the suitability of the HT water system. There are many hundreds of HT water installations operating abroad and a rapidly growing number in the U.S.A. It may be *just right* for *your* requirements.



Advantages of the C-E Hot Water Boiler

Once it is established that HT water is right for your needs, your next concern is selection of proper equipment. The C-E LaMont Controlled Circulation Hot Water Boiler has inherent advantages that make it the best possible choice. It is especially designed for HT water applications utilizing as it does the principle of forced, controlled circulation which is extended throughout the entire system. This accounts for numerous points of superiority in the C-E LaMont Hot Water Boiler. Among these are:

1. Complete control over HT water movement in both system and boiler.
2. Low pressure loss is inherent so no separate boiler pump is required.
3. Pressurized operation with oil or gas means no induced draft fan — simple stack.
4. Single-pass design — no baffles... low draft loss... cleaner boiler.
5. More efficient heating surface can be arranged because of positive, controlled circulation.
6. Other features such as: steel enclosed setting — few headers, all accessible — any fuel, oil, gas or coal.

The C-E Hot Water Boiler is available in sizes ranging from 15 to 200-million Btu per hour, or more, with pressures up to 300 psi and temperatures to about 425 F.

If you are in the market for a heating or process system — or expect to be — by all means investigate high temperature water and the C-E LaMont Hot Water Boiler. Our engineers will be pleased to discuss the subject with you or your consultants. Write for our new catalog HT-20.

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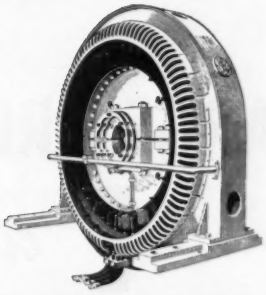

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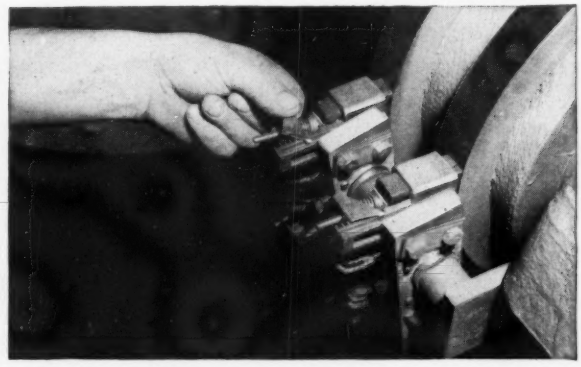
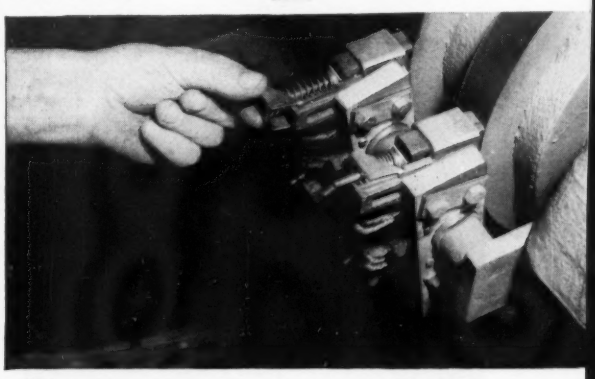
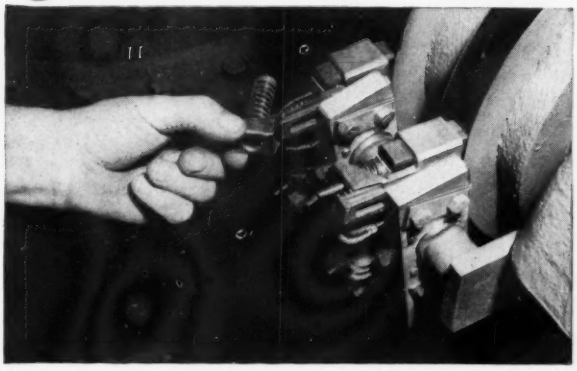


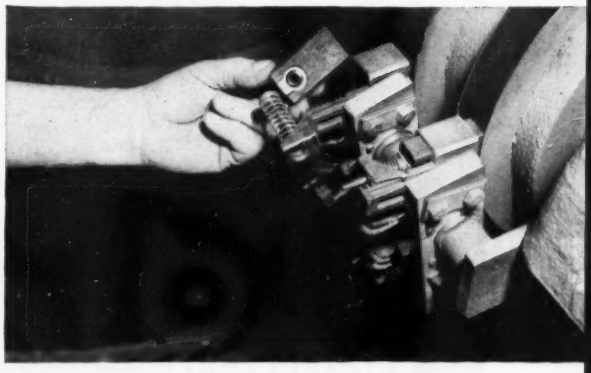
10 seconds. To start changeover, unscrew lead, release lock.



15 seconds. Slide lock back.



25 seconds. Swing locking device to one side. Remove old brush.



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ON THE COVER

EVERY now and then some daredevil rides over Niagara Falls in a barrel or some other container and a few such hardy souls have even survived the experience. The safest way to go over, however—if you have to go—is in a bucket attached to a strong wire cable as our cover man did. He is Harry Green, a geologist for the Hydro-Electric Power Commission of Ontario. He was examining the undercut at the Canadian flank of the Horseshoe Falls to determine the best position overhead for building a retaining wall to enclose a triangular area about 100 feet on a side. When filled in with rock, it will keep the river farther offshore and also serve as a vantage point for sightseers.

IN THIS ISSUE

FOR more than half a century man has been steadily reducing the volume of water pouring over Niagara Falls; borrowing it above the cataracts and returning it downstream after using its falling force to generate power. Efforts are now being made to preserve the appearance of the falls by spreading the remaining water out thinner and otherwise controlling it. Our leading article reviews the progress of the construction program designed for that purpose and also describes a bit of the rock surgery undertaken to control erosion at Bridal Veil Falls, a comparatively minor performer in Niagara's world-famous show.

•

TOMBSTONE, Ariz., is perhaps a dead mining camp, but it is still very much alive as a tourist attraction and its residents want to keep it that way. Now underway as the first step in that direction is the creation of a museum to house mining mementos and relics. Heading the work is C.M. Palmer, Jr., who, starting on page 261, tells us a lot about Old Tombstone's mining history.

•

JOSEPH HENRY might well be termed the unknown American scientist. A contemporary of and advisor to Lincoln, he made important contributions to the knowledge of electricity and did other notable things that have somehow escaped general attention. A brief sketch of the man and his accomplishments starts on page 270.

•

TO function well, all parts of a compressed air system must be designed to work together. A weakness in any one of them will cause faulty operation throughout. Hose couplings are relatively small components of the whole set-up, but that is no reason why they should not receive careful attention, as the article starting on page 272 points out.

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TRIMMING JOB AT BRIDAL VEIL FALLS

With the uppermost strata already removed, workmen on the shelf are drilling holes for shooting off the next lift. The purpose is to create an even vertical face in place of the irregular one previously there and forestall or slow down future undermining and crumbling. The stream that normally feeds the falls has been virtually dried up. The picture was taken from Goat Island, looking across the American Falls, with Rainbow Bridge in the distance.

More Face Lifting at Niagara

Rock Drillers Are Trimming Off the Precipice at Bridal Veil Falls

C. H. VIVIAN

VISITORS to Niagara Falls—and there are around three million of them annually—are seeing a double feature these days. In addition to the stellar attraction of the cascading stream, they can view at close hand some interesting and at times spectacular rock surgery. Most of this face lifting was planned, but one bit of it is an extra job that was decided on rather suddenly to check the ravages of natural destructive forces.

The Niagara, a 36-mile northward-flowing link between lakes Erie and Ontario is, for the most part, a placid, peaceful stream. But in a 5-mile stretch that includes the falls it is truly tempestuous. There it registers more than half its over-all fall of 326 feet. Aside from the sheer drop of 160 feet at the precipice, the immediate approaches in the Upper Rapids on each side of Goat Island are so steep that the water reaches speeds of up to 25 miles per hour.

As is well known, the falls are gradually receding. Geologists say they have backed upstream 8 miles in 22,000 years. Actual records kept since 1764 show that the Horseshoe Falls on the Canadian side has retreated 865 feet in the interval of less than two centuries. The rate has been somewhat slower on the American side because there is less water there. More than half of the total erosion was recorded in the first 78 years. From 1842 to 1905-06 the annual rate of recession was 4.2 feet. During the next 21 years it averaged 3.2 feet, and since then (1927) it has been only 2.2 feet. The reason for the decline is that power-generating schemes have reduced the volume of water going over the falls. These works take water out above the precipice and return it downstream. With six plants already drawing upon the river, Canada is completing another one and the United States is still to build a station that has been allotted it by international agreement.

The falls are important then for two things: power and scenery. The aim is to develop most of the potential power but, at the same time, to preserve the majesty and awesomeness of the spectacle. That is the purpose of the program now underway. It stems from an agreement made between the two nations in 1950. The idea of doing something to remedy and curb deterioration of the falls by erosion was first discussed during the previous century, and serious studies of possible ways of doing it have been made since 1905. The matter came to a head during World War II when both Canada and the United States were drawing full available power from the

falls hydro plants and wishing there were more of it.

During the years 1942-44 a submerged weir or dam extending 930 feet out from the Canadian shore was built about 1½ miles upstream from the falls by the Canadian Niagara Power Company Ltd. Although its primary purpose was to divert additional water to the intakes of the power tunnels, it also served to maintain the natural level of the Chippawa-Grass Island pool and to increase the flow over the American Falls, thereby enhancing its beauty.

Under the terms of the Niagara Diversion Treaty of 1950 the two neighbor nations agreed to take more water from the river for power development, each to be allotted half of it. By reason of that pact, Canada is now well along with the construction of Sir Adam Beck No. 2 Station and appurtenant works which will deliver water to it through 8 miles of tunnels and open canals. We have made no start on this side of the line because we haven't yet decided whether the Federal Government, the State of New York or private interests shall build and operate the facilities.

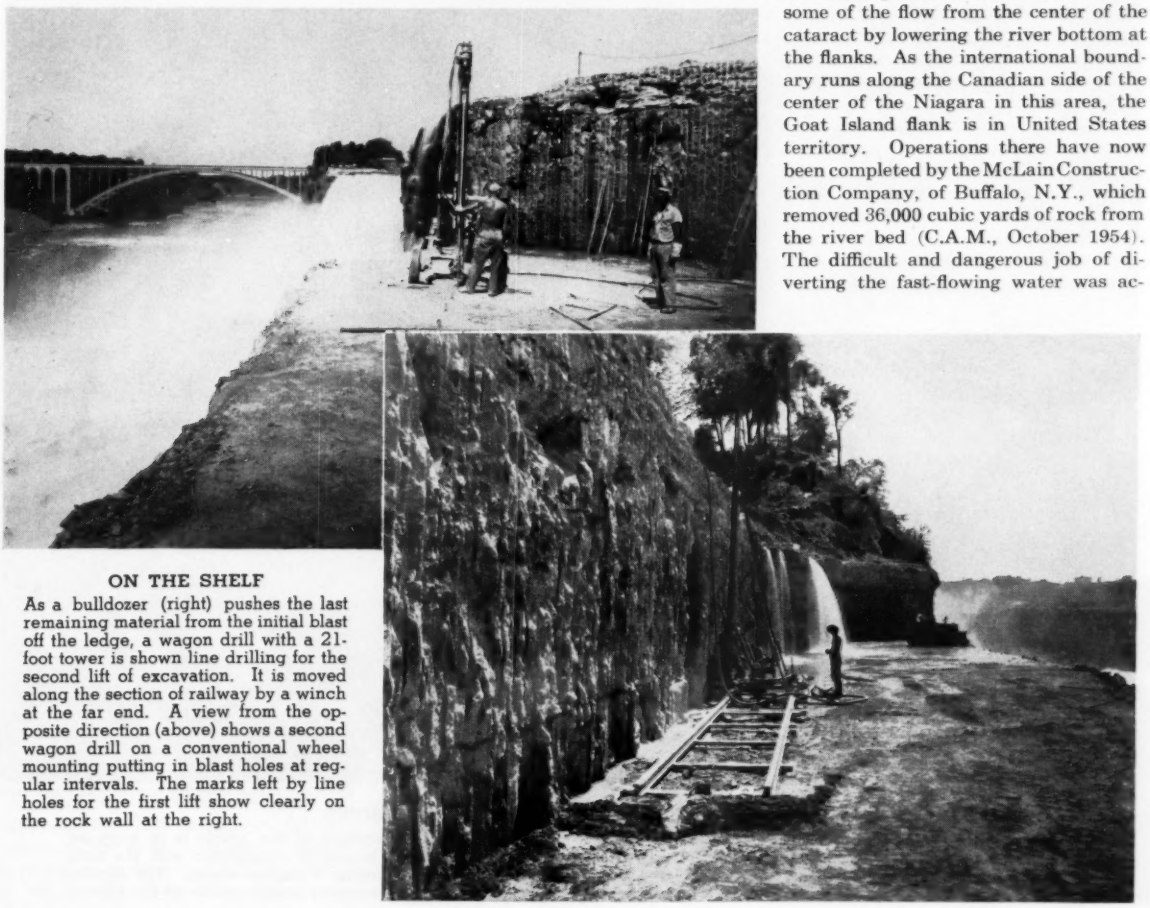
The flow of the Niagara, which represents the cumulative discharge of lakes Superior, Michigan, Huron and Erie, ranges between 170,000 and 230,000 cfs (cubic feet per second) and averages around 210,000. This is roughly 1½ million gallons a second, or 90 million gallons a minute. The latter quantity would meet the daily domestic requirements of a city of 900,000 persons, allowing 100 gallons per capita. In 10½ minutes the mighty river carries the equivalent of a day's consumption of water in New York City.

However, about 87,000 cfs is now being siphoned off to spin generators that develop around 1,500,000 horsepower of electrical energy. With the completion of the current 1,200,000-hp Canadian addition, and its American counterpart that is to come later, the total installed generating capacity will rise to 3,900,000 horsepower and the flow over the falls will be reduced so much that the cataracts will lose considerable scenic appeal unless something is done to spread the water curtains out thinner.

With just that in mind, the 1950 treaty stipulated that remedial works should be undertaken to effect a more even distribution of flow along the crest lines. It was recognized that a corollary benefit would be a reduction in the rate of erosion. The treaty empowered the International Joint Commission to work out the details of the plan and designated the U.S. Army Corps of Engineers and the Hydro-Electric Power Commission of Ontario in Canada to serve as the directing agencies for carrying out the actual construction measures in the respective countries.

The program thus mapped out, and which is estimated to cost $17,500,000, was commenced in December 1953 and is scheduled to be completed by 1957. One step is the building of the upstream Grass Island pool control structure. About 250 feet downstream from the submerged weir, this barrier is being extended 1550 feet from the Canadian shore and will contain thirteen sluices or openings, each equipped with a control gate. Its purpose will be further to control the water level in this area, which is the location of intake structures for both the Canadian and American power developments authorized by the 1950 agreement.

In the immediate vicinity of the cataracts the work will be limited to the Horseshoe Falls, which normally receives more than 90 percent of all the water by virtue of the configuration of the river bed upstream. The aim is to divert some of the flow from the center of the cataract by lowering the river bottom at the flanks. As the international boundary runs along the Canadian side of the center of the Niagara in this area, the Goat Island flank is in United States territory. Operations there have now been completed by the McLain Construction Company, of Buffalo, N.Y., which removed 36,000 cubic yards of rock from the river bed (C.A.M., October 1954). The difficult and dangerous job of diverting the fast-flowing water was ac-



ON THE SHELF

As a bulldozer (right) pushes the last remaining material from the initial blast off the ledge, a wagon drill with a 21-foot tower is shown line drilling for the second lift of excavation. It is moved along the section of railway by a winch at the far end. A view from the opposite direction (above) shows a second wagon drill on a conventional wheel mounting putting in blast holes at regular intervals. The marks left by line holes for the first lift show clearly on the rock wall at the right.

complished successfully and the bottom thereby exposed in the dry to drillers and blasters. In clearing away the rock, care was taken to restore the jagged surface much as it had been in order to churn the water and create the scenic white-capped rapids that have long characterized the stretch.

On the Canadian side, an even larger area is now being similarly treated by construction forces of the Hydro-Electric Commission of Ontario. The operation calls for removing 64,000 cubic yards of rock and likewise restoring the river bed to its previous uneven rapids-producing condition. In addition to excavating the flanks, their extreme outer edges will later be given the opposite treatment of filling them in. The object is to eliminate some small detached flows at each end of the Horseshoe Falls and thus create an unbroken curtain of water across the crest.

It is expected that these measures will suffice to preserve the magnificence of the falls, even with the new power plants withdrawing their quotas of water. However, to make doubly sure that the world-famous scenic effects will not suffer, the treaty contains the following provisions for "operating" the falls:

During the major tourist season of April 1 to September 15, a minimum of 100,000 cfs must be left to flow over the cliffs between 8 A.M. and 10 P.M. From September 15 to November 1, this regulation will apply from 8 A.M. to 8 P.M. During the remainder of the year, November 1 to April 1, the minimum flow will be reduced to 50,000 cfs, day and night, except when it is necessary to flush ice out of the gorge below the falls.

Two pieces of construction not on the program we have outlined have arisen somewhat on the spur of the moment as a result of Mother Nature's gorge-making processes. On July 28, 1954, a block of rock estimated to weigh 185,000 tons broke away from the brink of the American Falls at the extreme eastern end and fell into the chasm below. It took with it a portion of the sightseers' vantage station known as Lookout Point. Other cracks were opened up back of the new cliff, and it was necessary to do some drilling and blasting to insure the safety of the area. That was done immediately, and new facilities for visitors were provided. From downstream, however, the shoreward edge of the cataract has taken on a slightly altered appearance where the rock is now heaped up.

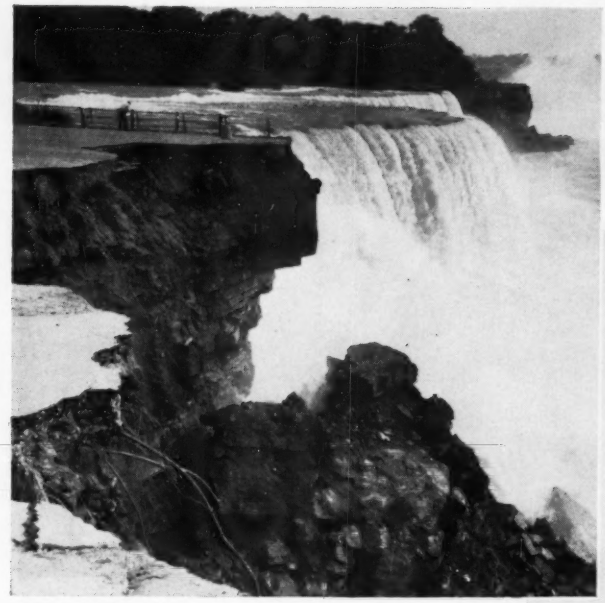
The occurrence of this sizable rock fall was the signal for a little investigation to determine whether there were other portions of the precipice in danger of tumbling or spots where some corrective work might be in order either to avert further immediate crumbling or to arrest the undercutting action which, in time, would inevitably lead to further recession. As an accompanying illustration shows, this undercutting takes place because some of the underlying strata are softer and wear away easier than the fairly durable limestone layer on which the stream above the falls now flows.

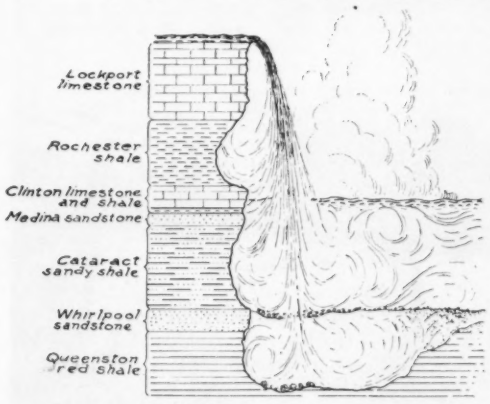
The investigation was conducted under the direction of A. M. Anderson, executive secretary and chief engineer of the Niagara Frontier State Park Commission that has charge of seven state parks along the river. It was noticed that there was an overhang, amounting

PHOTO, NIAGARA FRONTIER STATE PARK COMMISSION

ONE OF NATURE'S MOST DRAMATIC SHOWS

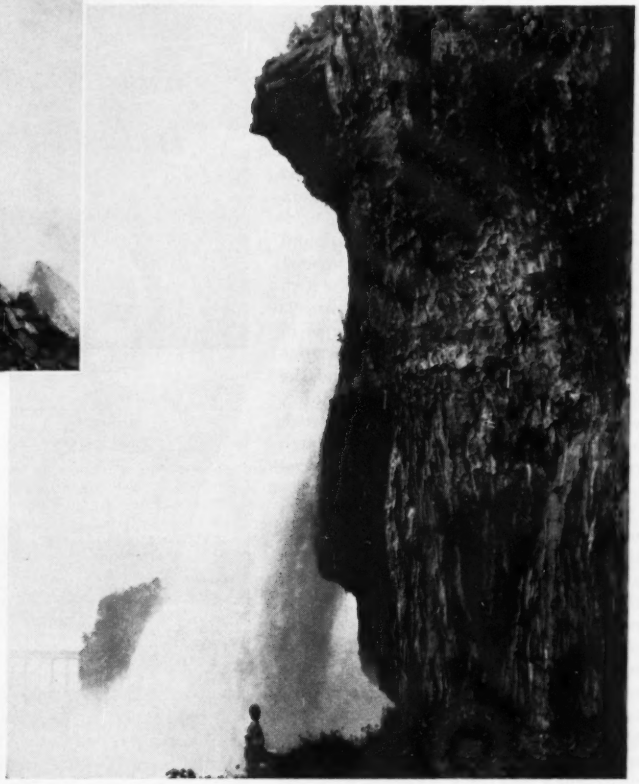
Oblique aerial view looking across Goat Island into Canada with the American Falls at the left, the Horseshoe Falls at the right and a powerhouse below them. The Upper Rapids are plainly visible. Bridal Veil Falls (white arrow), where the work described in this article is in progress, appears like a tiny rivulet in comparison with the main cataracts, but is in reality a sizable stream. The landing used by the tourist excursion boat is visible at the bottom.





WHY THE FALLS RECEDE

The drawing illustrates how the softer underlying shale and sandstone layers are worn away faster than the more resistant topmost limestone, thus undermining the latter progressively and causing some of it to drop from time to time. The picture below shows the actual overhang at one flank of Bridal Veil Falls before the current work began. At the left is the scene after 185,000 tons of rock toppled into the gorge at Lookout Point in July 1954. The American Falls is in the foreground, the Horseshoe Falls, with mist rising, in the background.



in places to around 30 feet, at Bridal Veil Falls between Goat and Luna islands near the center of the river. The stream above this cataract is only 100 feet or so wide and rather insignificant in comparison with the waters that feed the two major falls, but it is, nevertheless, important from a tourist standpoint. By making an elevator descent on adjacent Goat Island and passing through a connecting tunnel visitors emerge at the base of the falls and may follow built-up boardwalks and bridges to excellent vantage points. Above the falls there is a lookout at the Goat Island end, and a little upstream there is a rustic bridge leading across to Luna Island, with connecting walkways. A fine view of the gorge below, the Rainbow Bridge and the American Falls is afforded from the area thus reached.

A geologist was called in to give an opinion as to when the upper, jutting stratum might drop. He said it might happen in an hour or not for 100 years, and he wouldn't hazard a closer estimate. The commission decided, nevertheless, to go ahead with a precautionary "manicuring" job designed to beat Nature to the punch and put the cliff in condition better to withstand the effects of further erosion. Briefly, this calls for slicing off a section of the cliff, leaving a vertical face 90 feet high that will be more resistant to undercutting than the one of irregular line now there. The section to be removed is about 190 feet long and elliptical in shape and contains approximately 3300 cubic yards. At the surface it ranges in width from zero at the two ends to 30 feet in midsection. As the maximum undercut near the bottom of the cliff is also about 30 feet there will be little if any material to remove when the cut gets down to that level.

The work is being done under contract by the Walter S. Johnson Building Company, Inc., of Niagara Falls, N.Y. It is necessary of course that a clean, unshattered rock face be left. To insure this, Johnson elected to drill a line of holes along the back edge spaced close enough to provide positive breakage. In addition to the line holes, others are drilled on a regular pattern throughout the area to be removed and these are loaded with explosive to break the rock away from the back edge.

All drilling is being done with two Ingersoll-Rand FM-3 wagon drills, each mounting an X-71 drifter. The one doing the line-drilling has a tower 20 feet 7 inches high.

The excavation is being carried out in a series of lifts or steps, about six or seven of which will likely be required. The first lift had been completed at the time the job was visited, and the rock had broken out clean. As the sedimentary rock series being penetrated lies almost horizontal, it is possible by drilling to the top of a well-defined layer to produce a practically level floor or bench for the next lift. The distance had been gauged perfectly on the first lift, and this simplified setting up the drills for the next step.

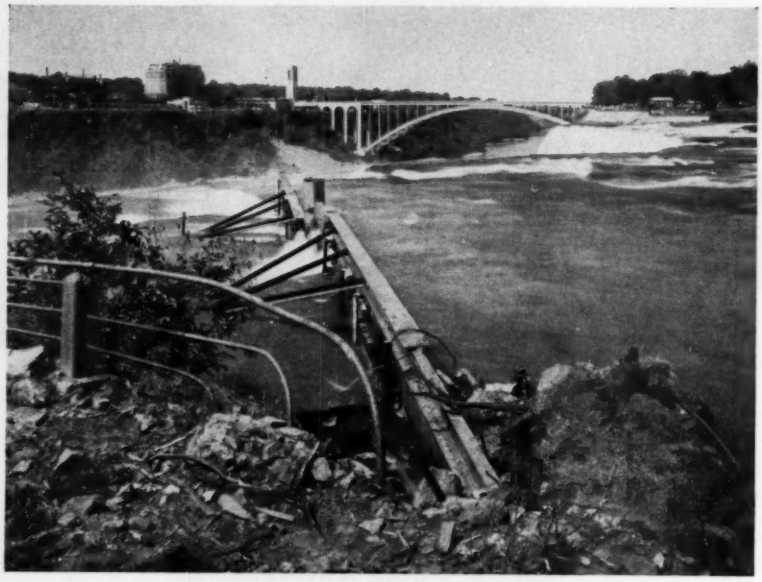
All drilling is being done with Carset

(tungsten carbide-insert) bits of 2-inch gauge. As only one drill rod per hole is used for line-holing, no stops are made to change, and an average of 600 to 800 feet of hole is being put in per day. As the blasthole drill has a lower tower, steel changes have to be made to finish each hole and this and other delays not experienced in line-holing reduce the average daily footage. In the limestone and shale formation bits are showing an average service life of around 800 feet.

Compressed air for the operations is furnished by three Ingersoll-Rand portable compressors: a 315-cfm Gyro-flo rotary, and two reciprocating units of 210-cfm and 105-cfm capacities.

The blasting procedure was worked out with the assistance of Horace Nunn of the Du Pont Company, and the consumption of powder runs about ¾ pound per cubic yard of rock. Before a blast is fired, a Koehring crane lifts the two drills up and out of range. Shooting is then done electrically with a series of delay detonators. A small space at one end of the shelf is next cleared and the crane lowers a Caterpillar D-4 bulldozer, which starts pushing the remaining rock over the edge. As soon as there is enough room to set up the drills they are lowered and resume work.

Before drilling could be started it was necessary to divert the stream forming the falls, and that was done by building a low dam across from Goat Island to the upper end of Luna Island. To accomplish this in the swiftly flowing water, the tower from the wagon drill now being employed to put down blastholes was attached to steel members welded to the end of the 70-foot boom of the crane. With the boom extended out over the swift current, a line of holes was drilled into the submerged rock and in each was lowered a steel rod 3 inches in diameter and weighing 125 pounds. Steel I-beams were placed against the line of rods and backed with sand bags.



DIVERSION STRUCTURE

To throw some of the water on the American Falls side of Luna Island offshore and away from the working site a little downstream, a steel-beam structure (top) was built in the raging current. It is held in place by steel pins placed in drill holes and by downstream bracing. The pin holes were put in by a wagon drill mounted at the tip of the 70-foot boom of a Koehring crane (lower picture).

WHERE TOURISTS STROLL

Rustic bridge between Goat and Luna islands normally used by sightseers to get close to Bridal Veil Falls but closed during current work.

Because this diversion dam shunted all the water around Luna Island, where it merged with that flowing down to the American Falls, the volume there was increased to a point where it threatened to overflow the outer side of Luna Island and interfere with operations at the brink of the cliff. To prevent this, another I-beam structure was built out from the island a short distance upstream from the working zone to throw the water farther offshore. Holes for this structure were also drilled with the help of the crane-boom setup.

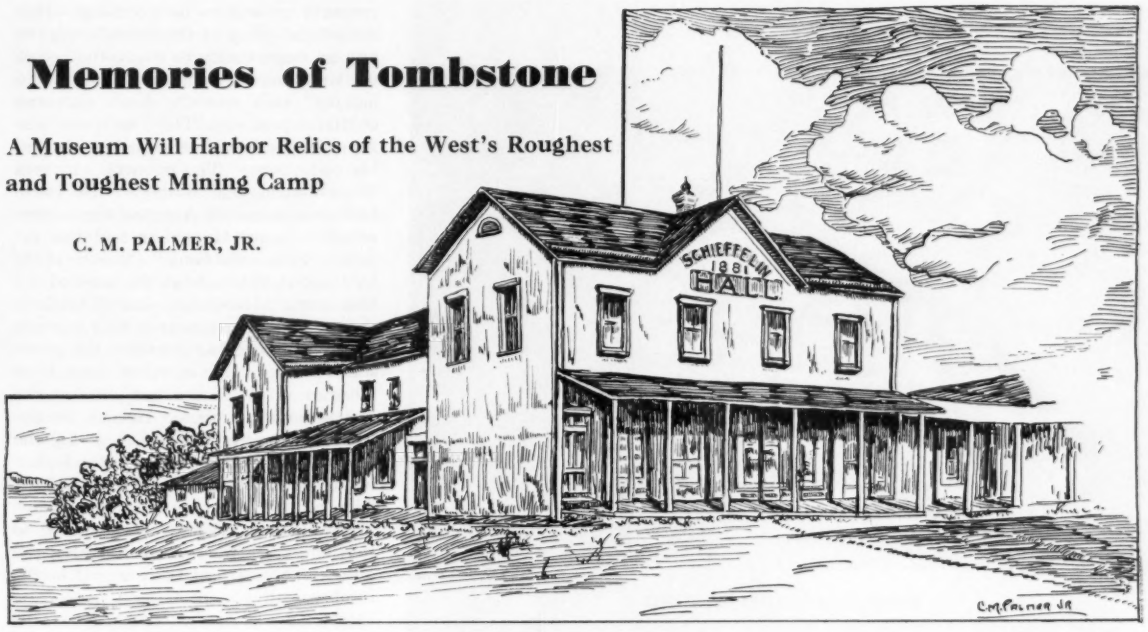
A small amount of water gets through the dam between the islands and flows down over the cliff to the shelf working location and thence to the river below. To prevent it from interfering with the operations, its course is changed as desired by routing it alternately through one and then the other fork of a Y-shaped ditch that was cut out with a PB-8 paving breaker where the stream bed approaches the edge.

Walter S. Johnson, head of the contracting firm, regularly visits the job, which is in direct charge of his son Jack. It is expected that the project will be completed before winter sets in.

Memories of Tombstone

A Museum Will Harbor Relics of the West's Roughest and Toughest Mining Camp

C. M. PALMER, JR.



SCHIEFFELIN HALL

Although other prospectors preceded Ed Schieffelin, he gave Tombstone its name and started it on its way to fame. Because Apaches infested the area, Schieffelin was told that if he persisted in looking at all the rocks he would find his tombstone among them. Remembering this, he named his first claim Tombstone (the second one was the Graveyard) and it was also adopted by the town that sprang up. Schieffelin Hall, called one of the largest adobe buildings ever erected, was built in 1882 by Ed's brother, Al. In addition to offices, it contains an auditorium and a stage that was once reputed to be the West's largest. John L. Sullivan, champion heavyweight boxer, and many stars of the theater appeared there. The Masonic Lodge now owns the building and meets in it. Also in it are the chamber of commerce and an exhibit of relics and mementos of old Tombstone collected and arranged by a restoration committee that is preserving and restoring the town's landmarks. Some of the accompanying drawings show mining equipment included in the collection.

"A MAN for breakfast every morning"—a dead man, that is. That's the gist of the usual story told of old Tombstone, the Arizona mining camp that was "too tough to die." These yarns glorify cowboys, who dealt mostly in other people's cows, and bandits, thugs, stage and train robbers, claim jumpers and murderers. There are old-timers in Tombstone who still insist that "those boys were not really bad—a little wild maybe, but not really bad." Nevertheless, their victims were robbed just as expertly and killed just as dead as were those of the more modern Dillingers, et al.

If you read most of the literature on Tombstone it is hard to believe that any really worth-while people ever lived there. But happily there were good folks in the old camp—strong, God-fearing folks who survived and outlasted, as they always do, the vicious. Anyone who roams the hills south of the camp cannot but be impressed by the fact that someone did a lot of grueling work out yonder. Those rocky hills have been drilled, tunneled and stoped the "hard way"—by manpower—for the precious metals they contained. Miles of drifts and hundreds of feet of shafts were cut through solid rock.

The old diggings are a maze of interconnected, confusing galleries at varying levels, even down below the water line. Too often of late these labyrinths have proved an irresistible lure to the unwary and overinquisitive. Some mines such as the Mountain Maid came up right in the middle of town. Others, like the Vizina and the Goodenough, were and are at the edge of Tombstone on Toughnut Street. In 1907 a cave-in of a Goodenough stope that had been cut too near the ground surface made the Million Dollar Stope. This great gap lures many strangers to frightful underground experiences. The wise go in only with an experienced guide and adequate lighting equipment. The wisest stay out alto-

TEN-HORSE TEAM

Many draft animals were required in the early days to haul the ore nine miles to the reduction mills on the San Pedro River. The team shown hitched to a double ore wagon was a small one; forty horses or mules were sometimes used.

STARTING UNDERGROUND

In the foreground is the Toughnut Mine during its transition from an open pit to an underground mine. In the background are the frame shacks and canvas tents of Tombstone. This is believed to be the earliest picture of the old camp now available. The Toughnut was Schieffelin's third discovery.

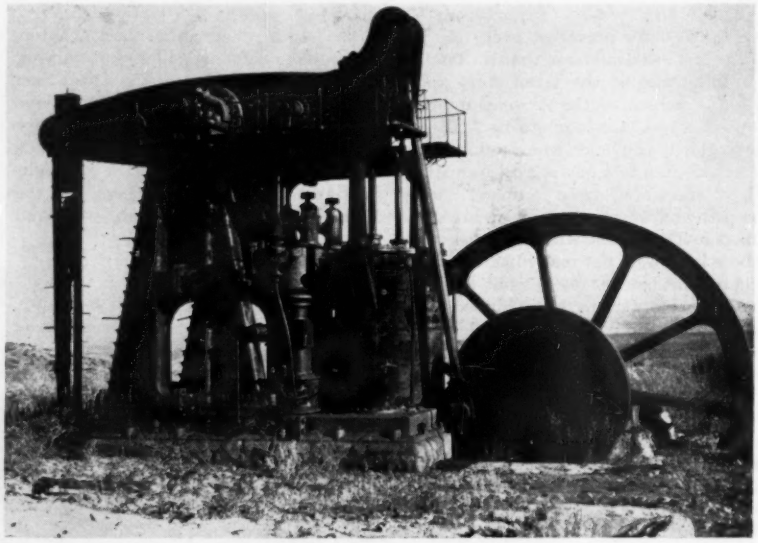
gether. But curiosity takes its toll.

The first attempt to capitalize on the mineral resources of the district was made by a German or Russian mineralogist named Frederick Brünckow shortly after the Gadsden Purchase. That was in about 1857 when southeastern Arizona was as wild as any part of the country ever was. The Apaches were rampant, smugglers prowled the borders, and bandits and cutthroats were everywhere. Brünckow lost his life to one of those lawless groups, and his was only the first of a long series of violent deaths near the site of old Charleston about 8 miles south of Tombstone on the old Charleston Road.

The original Brünckow Mine is still there at the edge of the road, and reports have it that sixteen men were killed by the Apaches while working that claim. The man who really founded Tombstone was Ed Schieffelin, and his first job when he came to the hills was to stand guard to keep the Indians off the necks of the two miners then working the property. Nearby are the walls of the old Brünckow 'dobe house that have stood for nearly a century. The structure has been called "the bloodiest shack in the history of the country," for it was the scene of even greater violence than the mine itself. Some 39 persons are supposed to have met death under its roof at the hands of Indians or outlaws. The remains of the building stand on a low knoll surrounded by higher hills, and it is difficult to understand how anyone could have approached the place without being seen. There are few today who know the mine by its original and correct name. It is more popularly called the Bronco and also known as the Brown Cow.

All that violence was futile, as the property proved to be worthless. But Schieffelin's stay at the Brünckow gave him an opportunity to study the lay of the land, and his eventual find of "likely looking" rock was the direct outcome of that experience. That, however, was fully two decades after Brünckow started his operations. The country was still just about as wild as it ever had been. Lawlessness and the Apaches were everywhere. Camp Huachuca had but recently been established (March 1877) by Captain Whitside at the head of the Huachuca Mountains, and Schieffelin arrived shortly afterwards with a group of Indian scouts to reinforce the garrison at the camp, by that time Fort Huachuca. Al Sieber was chief of the scouts, and his classic remark to the lonely prospector resulted in giving the town its morbid name. Asked by Sieber what he was doing in the hills, Schieffelin replied that he had found some "likely looking stones," or something to that effect. Sieber assured him that the only stone he'd find there would be his tombstone.

But Ed was neither alarmed nor dissuaded from his quest and, following the trend of the ledges north and east, found rich float in some of the draws. Seeking its source, he established the Tombstone and Graveyard claims. Then he went in search of his brother Al, whom he eventually located far to the north at Signal, Ariz. When assayed by Richard Gird, a mining engineer at Signal, the



OLD CORNISH PUMP

In the beginning there was not enough water to operate ore concentrating mills, but when the mines got down around 1000 feet, the lower workings had to be pumped constantly. In 1882, the first of two ponderous Cornish pumping engines was somehow hauled in on wagons and set up at the Grand Central Mine. A little later another one was placed at the Contention. It is probably the one shown here, as raised lettering on the castings that is visible on the original photograph indicates that the machine was manufactured by the Union Iron Works in San Francisco in 1884. The pump had a stroke of 15 feet, its flywheel was 36 feet in diameter and the walking beam across its top weighed 34 tons.

ore samples were found to run between $40 and $2000 in silver to the ton. Gird, himself, became much interested in the project and joined the brothers on their return to the Tombstone hills.

Those first two deposits, while rich enough, were shallow and petered out quickly. Al Schieffelin became discouraged, but Ed kept plugging and shortly announced another discovery. When his unimpressed brother heard the news he remarked: "You're a lucky cuss." Immediately the claim became and has remained the Lucky Cuss. So rich was the ore that it seemed as though pure silver was jutting out of the earth. With his fingers Ed was able to force a silver dollar into the soft metal and leave its impression there. Ore samples assayed as high as $15,000 in silver to the ton and about a tenth as much in gold.

Almost immediately after that strike Ed located another claim at the edge of the present townsite. That became the Toughnut because Gird experienced difficulty in determining the exact boundaries so as to be sure the best part of the deposit would be within the confines of the claim. Toughnut Street got its name from the mine at its head.

As word got around that Gird was leaving his job and joining the Schieffelins, other prospectors began drifting in. The third claim was staked by Oliver Boyer and Henry D. Williams after they had agreed to share any find with the Schieffelin-Gird combine. Reminded of the pact, the partners disavowed it at first but came through reluctantly after pressure was exerted. The share of the Schieffelins immediately became the Contention, which developed into the richest of all the Tombstone claims.

Practically every writer on this subject has stated that there was never anything but a verbal understanding between the three members of the Schieffelin-Gird partnership. However, congenial as the partners must have been, it is of interest that the Tombstone Restoration Commission has uncovered many old documents during the past four years among which is a series of apparently legitimate "certified copies" of agreements pertaining to nearly every project undertaken by the triumvirate and its other business associates.

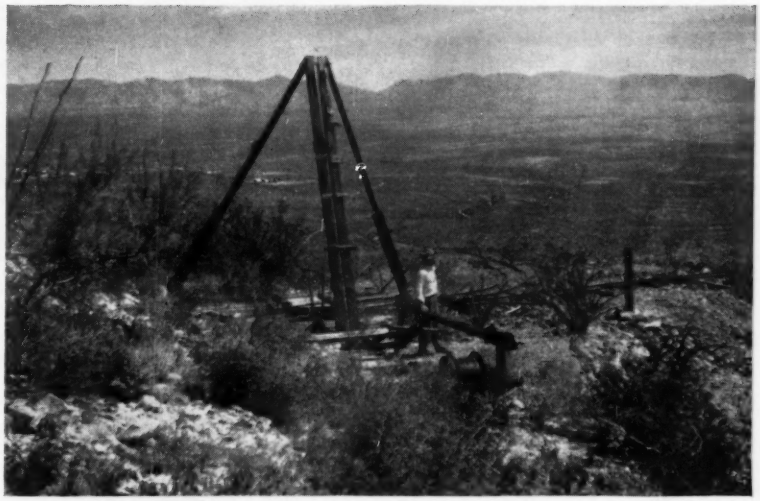
For example, there is the notice of location of the Goodenough mining claim, dated March 25, 1878, and signed by Ed and Al Schieffelin and Gird. It was "filed and recorded at the request of Richard Gird, April 9 A.D. 1878 at five o'clock, P.M. — S.W. Carpenter, County Recorder, Pima County." It was certified by A.T. Jones, recorder for the newly created County of Cochise, on December 5, 1881.

The creation of the Tombstone Mining District was signed by Gird and the Schieffelins, as well as by Boyer and Thomas E. Walker. On October 26, 1878, Al and Ed Schieffelin, along with Gird, J. S. Vosburg and A.P.K. Safford, later Governor of Arizona, organized and incorporated the Tombstone Gold & Silver Mill & Mining Company. The deal was witnessed by Walker and Frank Corbin. The truth and correctness of the copy was certified by Charles R. Drake, recorder, Pima County.

On September 27, 1878, the Schieffelin brothers and Gird entered into an agreement with Vosburg by which "an undivided one-fourth interest" in the Lucky Cuss, Owl's Nest, Contact, Ground Hog, East Side, Tribute, West Side, Defense, Toughnut and Goodenough mining claims and the Lucky Cuss mill site and water right was to be turned over to Vosburg in consideration of the "erection of a first class Ten Stamp Quartz Mill and construction of a ditch from dam on San Pedro River to mill, and road from mill to said mining claims."

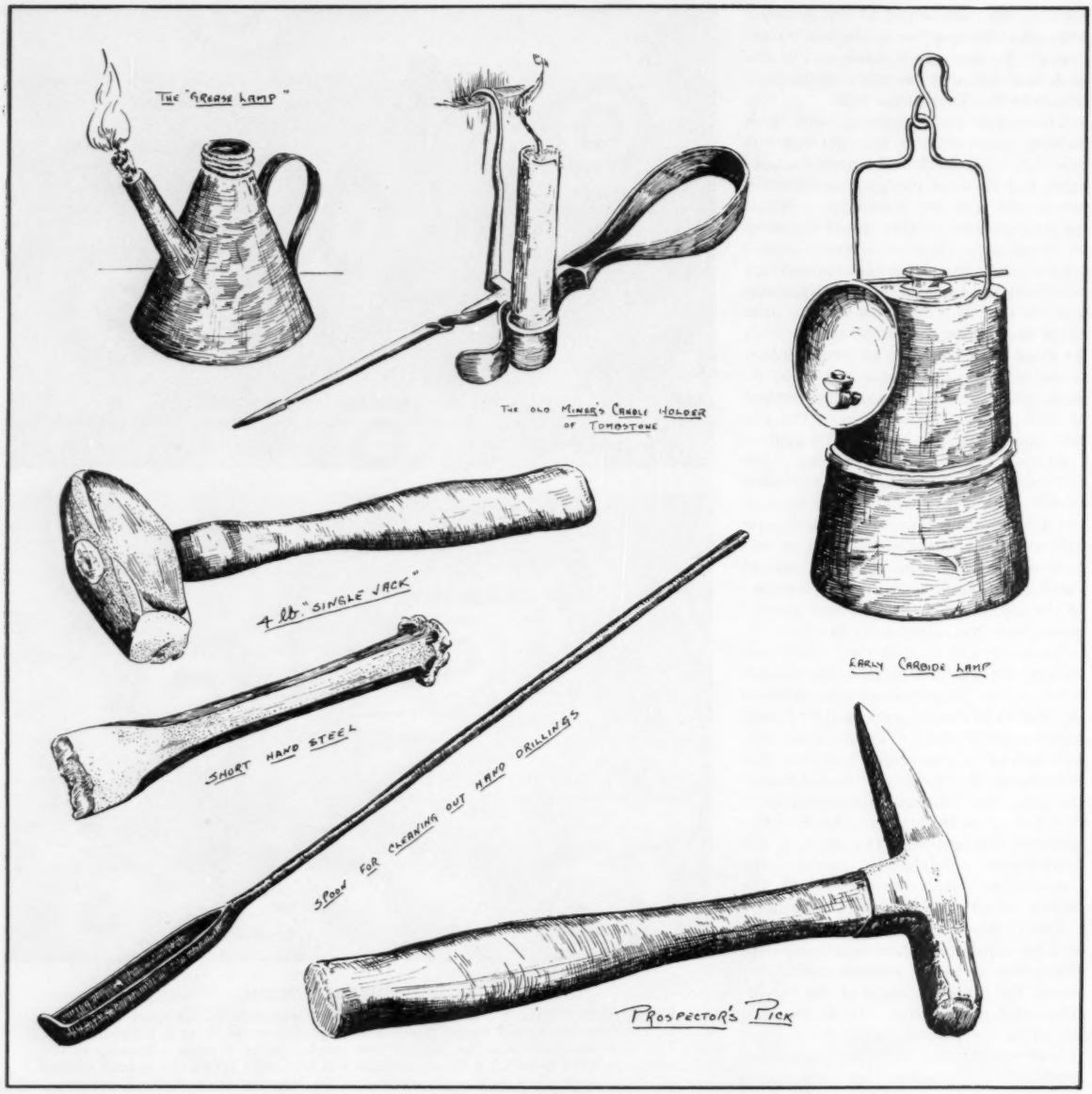
According to a contract between Vosburg and A.E. Corbin of Philadelphia, signed on October 1, 1878, the latter was to put up the money for building the mill, etc., and was to receive one-half of Vosburg's interest in the properties just mentioned, plus a one-eighth interest in the Lucky Cuss mill site and water right. That pact was witnessed by Safford.

At that time southeastern Arizona was a remote and dangerous country, far from railroads. There were no roads. Ed Schieffelin first rode in on a mule.



HORSE-POWERED WHIM

On a hill overlooking Tombstone and Goose Flats, with the Dragoon Mountains in the distance, an old tripod headframe (top) still stands over a long-idle shaft. The man stands beside the tongue and single-tree of a whim (close-up in the lower picture) to which a horse or mule was hitched. When the animal walked in a circle, the power was transmitted to the hoisting drum through gearing.


THE "GREASE LAMP"
THE OLD MINER'S CANDLE HOLDER OF TOMBSTONE
4 lb. "SINGLE JACK"
EARLY CARBIDE LAMP
SHORT HAND STEEL
SPOON FOR CLEANING OUT HAND DRILLINGS
PROSPECTOR'S PICK

UNDERGROUND LIGHTS AND HAND DRILLING TOOLS

These drawings by the author show old equipment once used in the mines and now in the Tombstone museum. The grease lamp came first, followed by the candle in a holder that could cling to the rocks or penetrate cracks. The appearance of the hammers and drill steel indicates that they were used long and hard.

All equipment was hauled in on pack animals or by freight wagons. The railroad came to Benson late in 1880, and that was still 25 miles from Tombstone. Not until 1902 did El Paso and Southwestern trains roll into Tombstone itself.

Mining equipment and methods of mining were, therefore, of a rather primitive type at the start and for some time afterwards. All drilling, for example, was done by hand with single-jack and double-jack hammers and hand-held steels. Black powder was the explosive. Prospectors dug with one eye on their work and the other on the surrounding country. In spite of their great yearning for the mineral wealth of Mother Earth, they realized that they couldn't enjoy it without the hair on their heads and their skin intact.

The miners used simple handmade wooden winches, raising their cowhide ore buckets to the surface by the strength of their backs and the sweat of their brows. The only metal parts of those buckets were a simple strap-iron ring around the top, a U-shaped piece passing under the wooden bottom and a heavy iron bail. Some of them are on display in Schieffelin Hall, Tombstone's newly created museum of old equipment. Eventually, as operations developed momentum, heavier equipment was brought in on great freight wagons powered by twenty or even more teams of mules and/or horses. They followed the beds of dry washes in lieu of roads until better routes were established.

Water has always been a serious problem, one way or another, for the Tombstone mines. In the beginning, lack of it made it necessary to build the mills for processing the ores on the San Pedro River 9 miles away, and a series of them

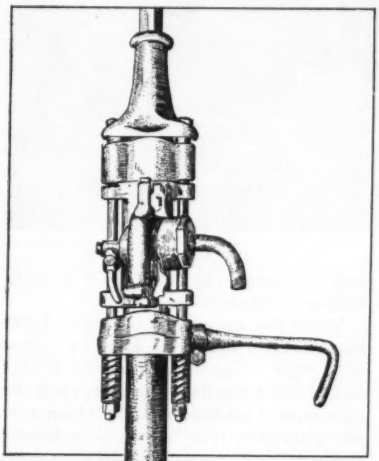
rose between Charleston and Contention City. The first one was the Gird Mill of the Tombstone Mill & Mining Company at Charleston or, as it was then known, Millville. The nearby Corbin Mill of twenty stamps followed soon thereafter. Then came the 10-stamp Sunset Mill and the Boston Mill, which was erected by the Boston & Arizona Smelting & Reduction Company about 4 miles below Millville. Two miles down river from Fairbank, Contention City developed around the mill of the Contention & Western Mining Company late in '79. During the following year the Grand Central Mill was constructed between Contention City and Fairbank.

That all happened, of course, before it was known that the Tombstone hills were practically floating on an inland sea or lake. That fact dawned on the camp as early as 1881 when water started seeping into the workings and pumping became necessary. By that time Tombstone was "the largest city in Arizona" with a population of about 4000! But there was still no direct rail connection with the outside world. In 1882 the Grand Central was drowned out and the first of the big Cornish pumps was installed to drain it. Even those giants were hauled in on freight wagons. Big as they were, and with one operating in the Grand Central and the other in the adjacent Contention, they were not equal to the task assigned them.

Water got to be more and more of a problem. Tombstone lies on Goose Flats approximately 4540 feet above sea level. The underground water table has been established at 4120 feet, or just about 420 feet below the surface. The depth to water in the various shafts depended on the elevation of their mouths in the hills. In the Grand Central and the Boom shaft of the Contention mining was being done below the 1000-foot level, but men didn't like to work there. It was treacherous going, always fraught with danger. It is said that when a drill (after 1902) struck water, the pressure drove the machine right out of the rock. When it was realized that there was sufficient water at the mines, the mills were moved from the river to the hills above the city.

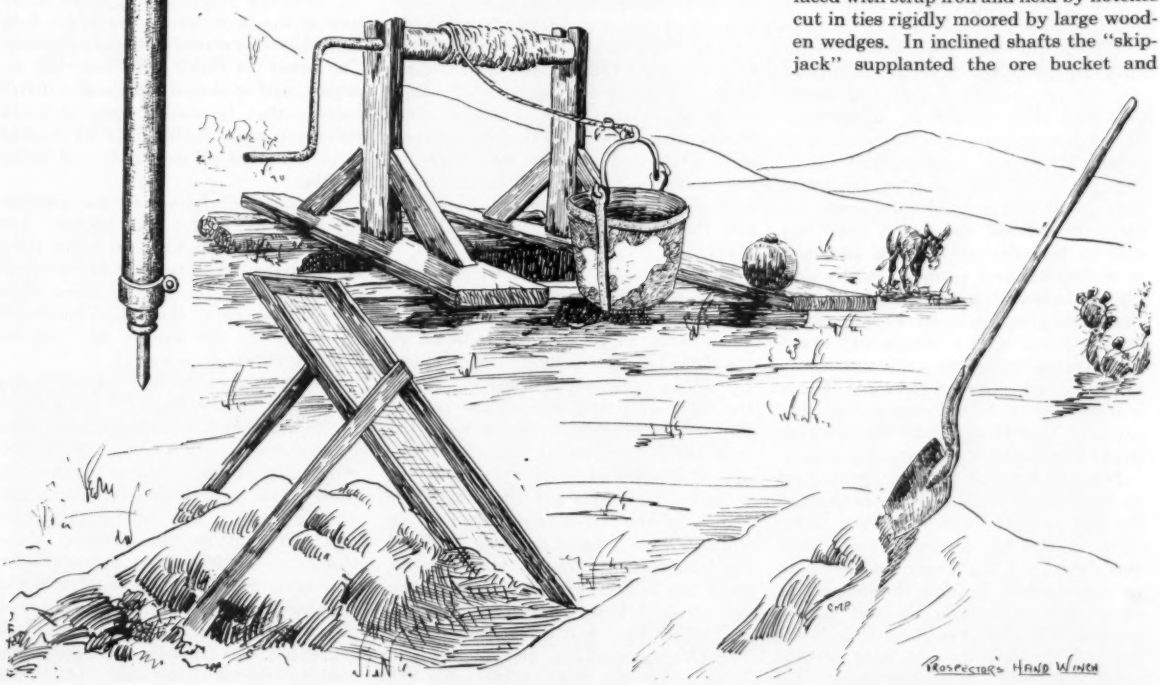
An anonymous writer for *Harper's Magazine* of March 1884 reported that "a laborer above ground earned $3.50 and below ground $4.00 for a 'shift' of eight hours work: and the work went on night and day, Sundays and all." The first miners to come to Tombstone were Americans, perhaps naturally, and also Cornishmen—"Cousin Jacks"— inherently the best of them all. They did monstrous things the hard way, and ripped fabulous fortunes from the bowels of the earth by hand methods. From the beginning to about 1901 or 1902, when the railroad finally got to Tombstone and machine drills were first used, approximately $25,300,000 in ore was taken out of the mines by hand!

Before machine drills arrived, the brawny miners with their 4-pound single-jack and their 8-pound double-jack hammers drove their steels at the conventional rate for those tools. At best, and under contest conditions, the most they could get by hand was 60 to 90 strokes per minute. Compared with modern drills that isn't much. Working areas were lighted by "grease lamps" and later by candles held in a unique and interesting holder. Mucking was done with picks and shovels, and wheelbarrows were used to haul the ore to the shaft where it was transferred to a bucket and lifted to the surface. Subsequently, wheelbarrows were replaced by ore cars which ran on wooden rails faced with strap iron and held by notches cut in ties rigidly moored by large wooden wedges. In inclined shafts the "skip-jack" supplanted the ore bucket and



PROSPECTOR'S HAND WINCH

The miner went down a ladder, filled the bucket, climbed the ladder, wound the load to the surface and screened the material to get "fines" for panning. Note the water canteen on the plank. At the left is one of the first mechanical rock drills used in the camp. It is a dry stoper made by J. George Leyner in Denver.



DOING IT THE HARD WAY

This rare picture, believed to have been taken in the Goodenough Mine, shows Tombstone "single-jackers" pounding drill steel in a stope by the light of candles in holders fastened to the wall. Note that some of the miners are striking overhand, others underhand.

also traveled on rails of the same sort.

In the museum are examples showing the entire evolution of mine-lighting equipment from the tallow grease lamp, the candle with its artistic wrought-iron holder (today a collector's item) and the old-style carbide lamp on to the lighter, more modern carbide lamp and the electric light on the miner's "hard hat."

The hoists used at the start were far different from those of the present day. The little hand winch was good enough for prospecting, but it could not lift ore out of the deep shafts of operating mines. For that they turned to horsepower, literally, or sometimes mulepower. The Joplin Whim was a mechanical device that converted the power of the horse from circular movement on a horizontal plane to vertical movement that was said to be sufficient to raise as much as several hundred pounds. It was simply a winch with a geared transmission that could give greater leverage for heavier loads and with a clutch and brake for lowering the empty bucket at a safe rate of speed. One of these old whims still stands on a hill overlooking the town. The Restoration Commission hopes to set it up in or near the museum.

Not the least of the feats performed in those early days was the hauling of the ore to the mills when the latter were on the San Pedro River. That was done by a big wagon pulled by 40 or more mules. Because the long string could not be backed up and turned around at the mine so it could go down the way it came up, the road at that point described a loop that was curved and graded carefully on the hilly terrain to insure the safety of the heavily laden wagons. Though the draft animals were mules, the "wheelers" were always horses. "Sid" Wilson, who drove many of those old jerk-line teams, relates that when mules served as wheelers they would often balk when they found they were hitched to a heavy load. Not so the horses. They would immediately fight the load until they got it moving, and then the mules ahead would take over.

The long team was guided and controlled by a single jerk line extending to the near mule of the pair in the lead. That beast, in turn, was connected at the bit to his partner by a "jockey stick" by means of which he pushed him to the right or pulled him to the left, as directed by the driver. The latter either rode the near horse of the wheelers or sat on a board atop the wagon. Theoretically, the team got its name from the jerks the driver gave the line to indicate "gee"(right) or "haw"(left) to the lead animals. But many teamsters, says Sid Wilson, varied this procedure according to their own ideas of how to do things. They just threw the long jerk line from one side of the mule to the other. Attached to the bridle reins, this had practically the same effect as neck-reining a saddle horse.

When the driver rode the wheel horse he controlled the brake lever by means of a rope. Going downhill he simply pulled the lever down and wrapped the rope around his saddle horn. There were no ratchets on the brakes, so releasing them on level ground was an easy matter. For the benefit of the lazier members of the team he always had a long bull whip and a ready supply of stones. The latter he threw with unerring accuracy, and so skilled did many a driver become that he could regularly make one stone serve double duty by causing it to richochet off one mule and strike another.

Just outside of town on the Charleston Road is a long, steady incline. The freighters used to keep an extra team there at the old settlement of Pick-'em-up to help haul the heavily laden, often double, wagons up the hill. There's not a sign of the old hamlet left, but the grade is as steep as ever.

Fire destroyed the hoist and pumping equipment of the Grand Central early in '86, and the Contention pump alone could not cope with the situation. Thereafter most mining operations were confined to the area above the water line, and it was not until the organization of the Tombstone Consolidated Mines Company in 1901 that any real threat was again offered to the water that had practically forced the mines out of business. Under the supervision of E. B. Gage, big, new triple-expansion Prescott steam pumps were installed late in 1902.

During the years they were in service those great units pumped on an average 5,000,000 gallons of water daily out of the mines. Eleven million gallons was the peak handled in one day.

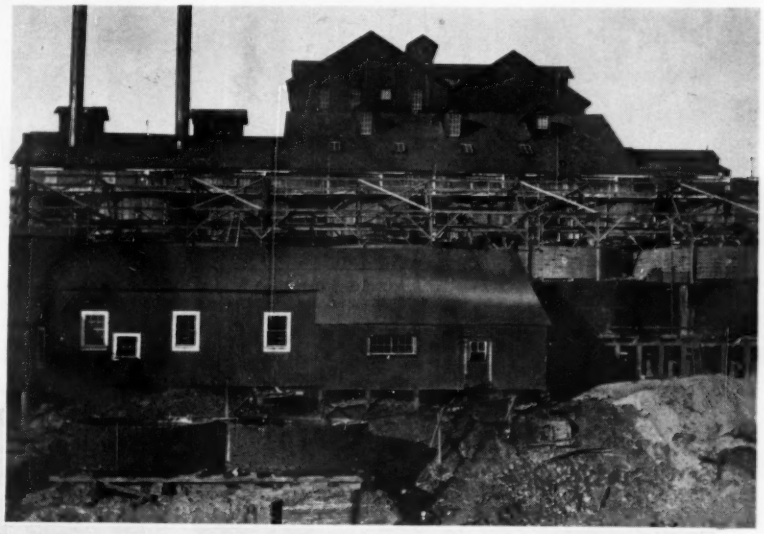
Along with the new pumps came the first of the machine drills. Jonathan Gordon states that they were used in the nearby copper mines of Bisbee as far back as 1896. But, like many new ideas, they were not accepted readily and were thrown out. Those early Tombstone machines were heavy, difficult to set up and hard to handle. Some of them weighed more than 400 pounds. One of the first of those drills, the old Cochise piston-type machine originally developed in Bisbee, is on exhibition in Schieffelin Hall. Also set up there in drilling position is one of the older Ingersoll-Rand machines, as well as one of the first George Leyner dry stopers.

Big and crude as those drills were, they accomplished much more than could be done by hand methods. They enabled miners to operate far more efficiently and at a greatly reduced cost. An idea of how much superior they were to hand drilling can be gathered from the fact that a team with double-jacks working under mining conditions could at best strike only about one-thirtieth as many blows per minute as a machine's 2000 or more.

But the problem of the Tombstone mines continued to be that of pumping water. In 1909 disaster struck when salt water instead of fuel oil was fed into the line leading to the pumps on the 1000-foot level. It was the practice to deliver the oil to the boilers directly from tank cars. When one was empty it was filled with salt water for the return trip to the coast for more fuel. Somehow, by a trainman's error, a car containing salt water was sent back to the mine. When that fluid reached the boilers they balked, and before matters could be remedied the pumps stationed on the 1000-foot level were submerged. Next those on the 900-foot level, and then the whole system collapsed. That was the beginning of the end of big-time operations in Tombstone. Since that time most of the work has been done on a smaller scale with lessees taking over most of the more promising claims.

How the eyes of the old-timers would bug out if they could come back and have a look around. How those old hand drillers would stare at the lightweight (less than 40 pounds) machine drills with their tungsten carbide-insert bits, the latest mucking machines, the newer hoists and the huge auto dump trucks for hauling ore! What would they think of modern lighting equipment and of all the facilities we now have for harvesting the precious metals from their deep rocky beds? And what would they think of today's pay check—and also Uncle Sam's take from that check? Yes, they'd have plenty to marvel at.

Many times has the following question been asked: "Why don't they drill into the sides of the Tombstone hills and drain the water out of the mines into the San Pedro River?" The answer is simply that water won't run uphill. The river level at Fairbank is 3859 feet, just 260 feet below the water level in the mines. Engineers have determined that it is not possible to lower the water any appreciable degree by such drainage. However, in this age of miracles, who knows what the future may hold for the waters in the Tombstone mines. *Quien sabe, de veras, compadres?*

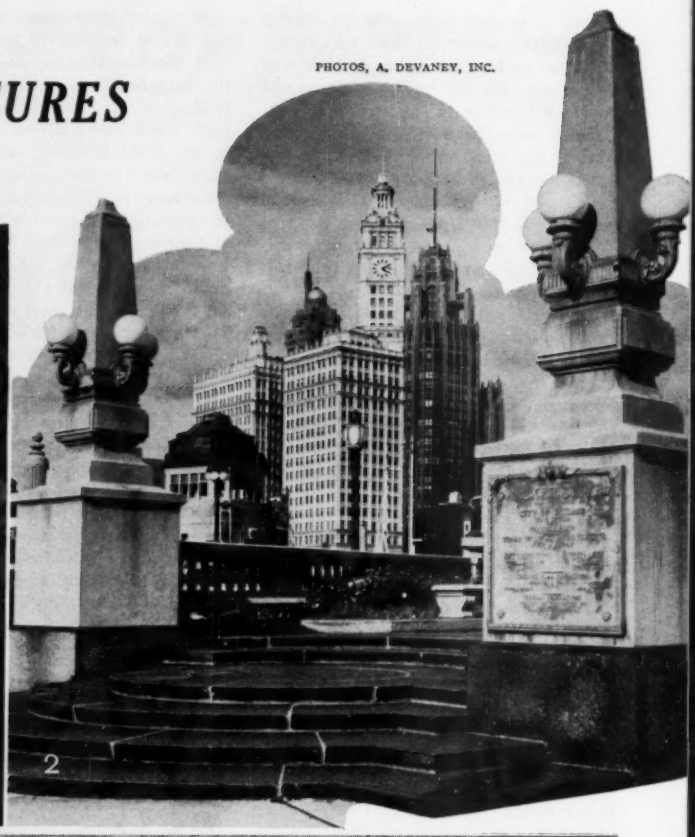


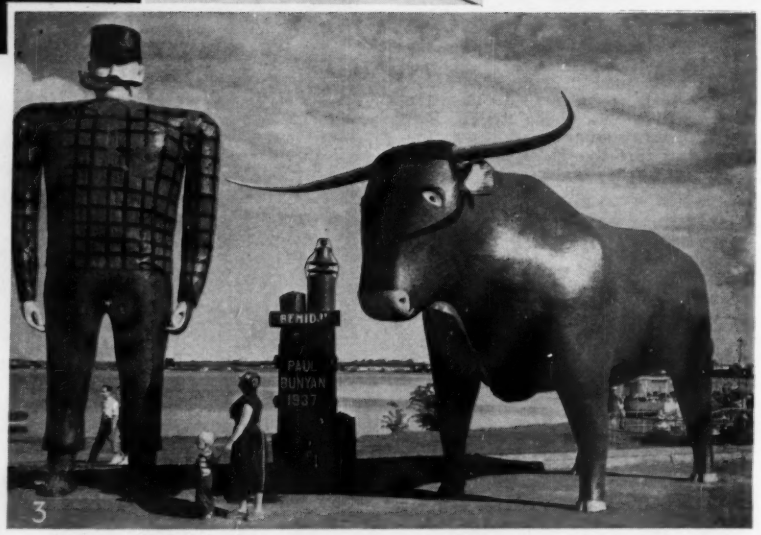
MINE BUILDINGS

Sizable structures existed during the mining heyday. At the right are those at the Boom shaft of the Contention Mine sometime after 1901, when the Tombstone Consolidated Mining Company became active in the district. The other picture shows the Consolidated mill for treating the ores.

AMERICA IN PICTURES

PHOTOS, A. DEVANEY, INC.



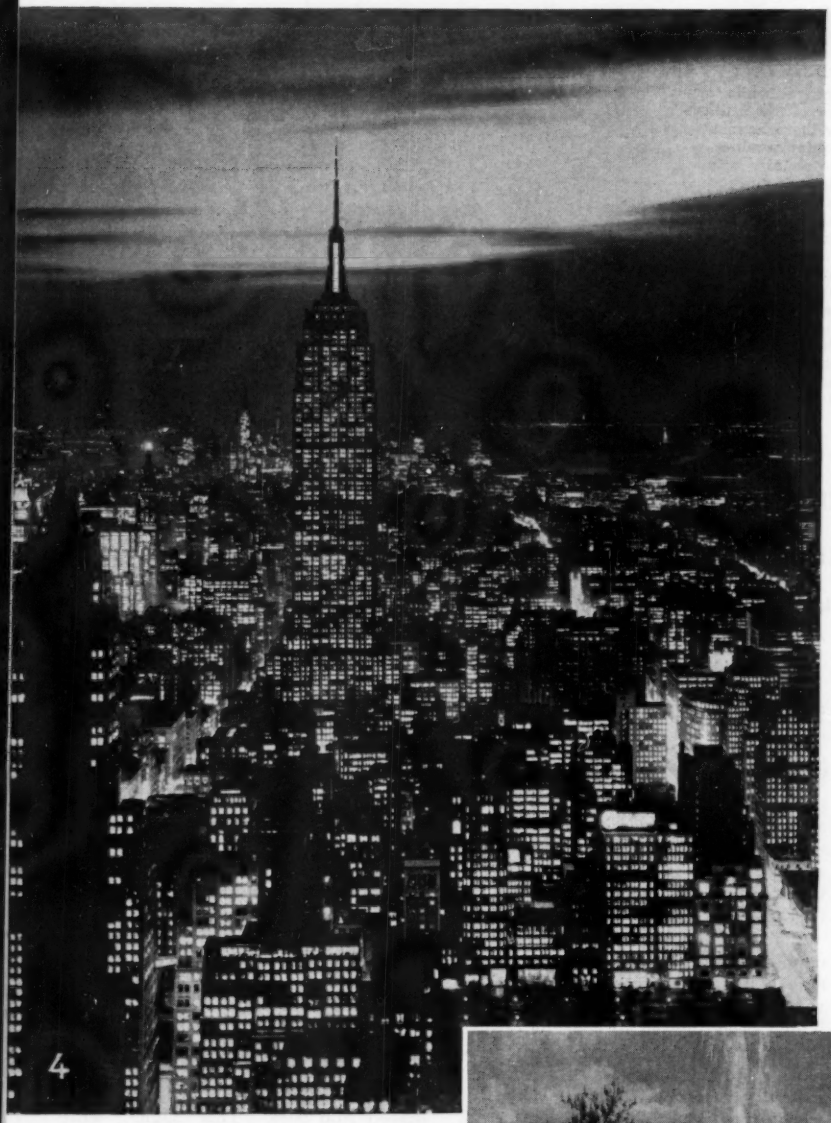


MILLIONS of Americans are on the move this vacation season looking, relaxing, and becoming better acquainted with the ever-changing physical face of this vast land. Pictured are some of the sights that will attract many of the travelers. Four of the scenes are in metropolitan areas; the third shows a memorial to a great figure in American folklore. All are notable examples of the multifaceted construction art.

1 The dome of the National Capitol in Washington, D.C., is the second one built. It was started 99 years ago and completed a decade later. It is of cast iron, measures 135 feet across, has 108 windows and rises to a height of 287 feet in the center of the 3½-acre structure. The statue of Freedom that surmounts it is of bronze and weighs 14,985 pounds. Modeled in plaster by Thomas Crawford, it was cast by Clark Mills. It has been in place since 1863.

2 Pylons on Wacker Drive, Chicago, Ill., frame two of the city's notable office structures. Seemingly, but not actually, the highest is the central terra cotta-clad Wrigley Building with its French Renaissance architecture and campanile tower, immaculately white by day, incandescent at night. It rises 32 stories to a height of 398 feet. To the right of it is the Tribune Tower, home of a powerful newspaper. Constructed of soft-toned Indiana limestone, it resembles a Gothic cathedral even to the simulated flying buttresses near the top. The building has 36 floors and is 462 feet high.

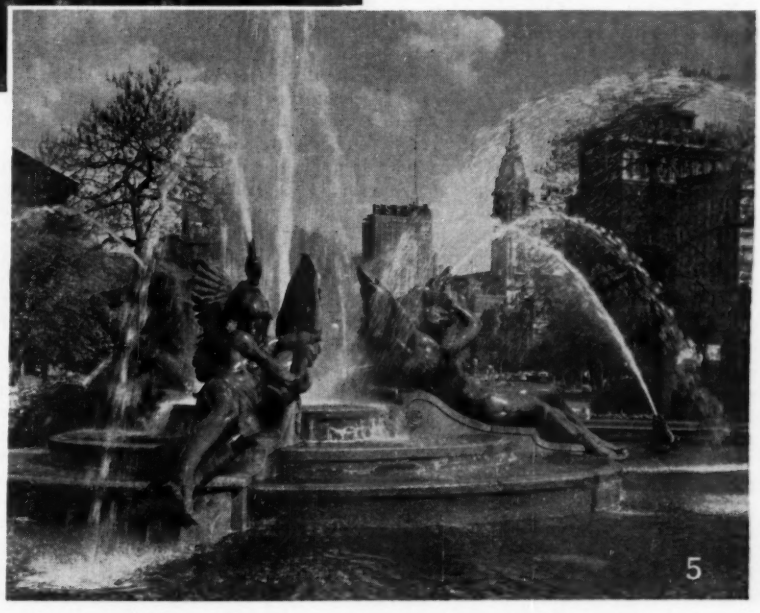
3 In Bemidji, Minn., the amazing mythical exploits of Paul Bunyan and his blue ox, Babe, are commemorated by huge steel-and-concrete statues on the waterfront. They were part of a setting for a Paul Bunyan Carnival staged in 1937. Cyril Dickinson, a local construction man, was delegated to erect the figure of Paul. Earl Brucklen, who was mayor at the time, served as the model,



and his measurements were scaled up 3 to 1. Paul is 18 feet high, weighs 2½ tons and stands on a 5½-ton concrete footing extending to water level.

Two members of the Bemidji Rotary Club, Newell Johnson and James Payton, built the fabulous ox. The largest of a pair of animals in the section was the model. The proportions, again on a 3-to-1 scale, are accurate, except that the front legs were spread apart to permit a truck to be driven underneath so that the statue could be transported to nearby communities on festive occasions. The horns are of tin and have a 14-foot span. In cold weather the nostrils emit smoke to simulate breathing.

4 Any schoolboy knows that this is Manhattan at dusk. The central structure is, of course, the Empire State Building, 1472 feet high not counting the 222-foot television sending tower. The view is towards the south—downtown. On the right is the Hudson River merging into the upper bay. The lights in the windows do not signify that the office workers are still there; in most cases they are for the benefit of the army of cleaners that takes over at the end of the business day.



5 The fountain is in Logan Circle, Philadelphia, Pa., and faces Franklin Institute on the Benjamin Franklin Parkway at Twentieth Street. Originally called Logan Square, it is one of five squares laid out by William Penn. It was named for Irish-born James Logan, who, as Penn's representative, held numerous offices in the Pennsylvania government in the eighteenth century. He wrote on literary and scientific subjects and was one of the founders of the University of Pennsylvania. He gave his large collection of books to the Philadelphia Free Library, where it is now housed in a separate section.

The fountain was erected in 1924 by the Philadelphia Fountain Society with funds bequeathed by Maria E. Swann and is a memorial to her husband, Dr. Wilson Cary Swann. The sculptor was A. Stirling Calder, son of the man who did the figure of William Penn on top of City Hall and father of the present-day "Sandy" Calder. The three figures represent the streams that bound Philadelphia: the Delaware and Schuylkill rivers and Wissahickon Creek.

In the middle background is the Pennsylvania Savings Fund Society Building, second tallest structure in the city. It numbers 39 stories and is 491 feet high.

JOSEPH HENRY

The scientist as he appeared while serving as the first director of the Smithsonian Institution. While there, he set up a system of getting regular weather reports from all over the country by telegraph, and this led later to the formation of the U.S. Weather Bureau. He persuaded James Lick to establish his famous observatory in California. He was an advisor to Abraham Lincoln during the Civil War and in the 1850's recommended that the U.S. Navy build an ironclad gunboat according to plans reviewed by a commission of which he was a member. The other commissioners discouraged the idea, and when war broke out the design was followed by the Confederacy in building the "Merrimac."

BETTMANN ARCHIVE PRINTS

Joseph Henry

He Opened the Door to the Electrical Age

Fremont Kutnewsky

ALBANY, New York, in 1815, was a small island of Dutch dominated civilization far removed from the momentous events that stirred the outer world. General Jackson defeated the British at New Orleans in a battle fought after peace was signed at Ghent, Belgium. Napoleon erupted from Elba for a hundred-day fling and Waterloo. The War of 1812, the surge of American migration westward, the revival of scientific inquiry that was exciting Europe—all had but little influence on life in the river town of Albany.

Yet, in that out-of-the-way place, a spark of genius was fanned into flame when Joseph Henry, a youth in his sixteenth year, picked up a book by an English clergyman entitled: *Lectures on Experimental Philosophy, Astronomy and Chemistry for the Young.* Years later, the renowned Prof. Joseph Henry of Princeton University wrote on the flyleaf of the book: "It opened to me a new world of thought and enjoyment; invested things before almost unnoticed with the highest interest; fixed my mind on the study of nature, and caused me to resolve that I would immediately commence to devote my life to the acquisition of knowledge." That he did, and so effectively that he became America's outstanding physicist of the nineteenth century.

Young Henry taught in a country school in order that he himself might go to school at night. He made such a record in his courses that the Albany Academy invited him to become a member of its faculty to teach mathematics and science. A natural-born instructor, he had a way of explaining scientific matters so that everybody could understand them. His ingenious demonstrations in class gave students a happy reprieve from dull textbooks. His fame spread in the community, and he was asked to make talks to groups on scientific subjects. In the course of one of these lectures he demonstrated the refrigerating powers of compressed air.

Placing half a pint of water in a strong copper vessel, he pumped air at a pressure of 9 atmospheres into it, causing the container to become warm. After it had been allowed to cool, he opened its stopcock. Out rushed the air, violently, carrying particles of water that instantly turned into snow. When the outlet tube was filled with ice he unscrewed the neck of the vessel and the chilled compressed air, expanding rapidly as it escaped, absorbed warmth from the water and made it freeze. Fifty years later this principle was the basis of mechanical ice making.

It was one of history's most charming coincidences that while young Joseph Henry was taking up the pursuit of knowledge with evangelistic fervor James Smithson, an elderly and wealthy English gentleman and life-long devotee of scientific research, was preparing his famous will. Under it the United States "inherited" half a million dollars in trust for the founding of the Smithsonian Institution whose sole purpose was to be the "increase and diffusion of knowledge among men." And who in all the country should be chosen as head of the institution twenty years later but the then Prof. Joseph Henry of Princeton University. Henry's appointment to the chair of natural philosophy at Princeton, at the age of 33, came as a result of his original researches in electricity, then little more than a mysterious toy.

The Danish physicist Oersted had discovered that electric currents had magnetic properties. He revealed that a charged wire would activate a compass needle and that a magnet exerted force on the current-carrying wire. Sturgeon, in England, had made a crude electromagnet by wrapping a few turns of wire around a bent iron core. When he sent an electrical charge through the wire the magnet picked up a piece of iron. Henry went much farther. He wrapped many coils of wire around a horseshoe-shaped iron core. This magnet, with current from less than a pint of dilute acid acting on two handbreadths of zinc, lifted 750 pounds. When he insulated the wire with silk-thread windings he got a magnet with a maximum lift of 3300 pounds. This startled the scientific world and led to renewed research in electricity.

One day Henry astonished his class by stringing 100 feet of wire around the room and inducing a magnet at the far end to ring a bell. It was, in fact, an experimental telegraph. He discovered the law of proportion between electromagnetic force in the battery and the resistance of the magnet. He worked out for the first time the separate functions of two entirely different kinds of electromagnets, one surrounded by numerous coils of short length and the other by a continuous coil of great length. By stepping up the current this made it possible to transmit it over a great

distance with little loss. It was all that Samuel F. B. Morse needed to make his electromagnetic telegraph system a success.

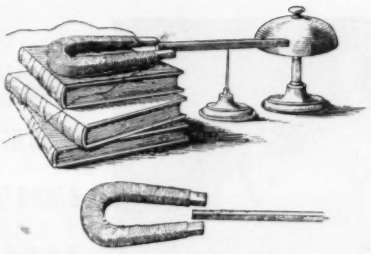
In 1829, Henry constructed the first electromagnetic motor, an oscillating machine with automatic pole changer, that was the forerunner of all electric motors and generators. He had solved the problem of developing electricity by means of a wound armature turning in the field of an electromagnet. Every electric generator and motor today uses the electromagnet in the form in which Henry left it in 1829. Nobody at the time thought that electricity would do the work of steam power because steam was needed to produce it.

Following upon the heels of his discoveries in induction, Henry transmitted electrical force without wires through floors and walls of buildings, and in one case magnetized a needle from a lightning flash 8 miles away. He brought out the fact that a second induced current could induce a third, the third a fourth and so on, and that these currents could be induced at a distance. This radiant power of electricity is, of course, the basis of electronics as used today in radio and television broadcasting.

Although Henry was slow to publish his findings, and so lost the widespread credit that might have been his (it went, instead, to Faraday and others in Europe), word did get around. When he was appointed to a chair at Princeton, Sir David Brewster wrote: "The mantle of Franklin has fallen upon the shoulders of Henry." Had he published more fully, as Prof. Asa Gray of Princeton pointed out, his name might have been prominent among the pioneers and founders of the doctrine of conservation of energy. However, honors come, though sometimes late. In 1893, fifteen years after Henry's death, the International Congress of Electricians at Chicago gave his name to the standard unit of inductive resistance—the "henry."

When Henry accepted the first secretaryship of the Smithsonian Institution he had to turn his back on his beloved researches in electricity. But like Franklin, who invented a heating stove, bifocal glasses and gave the French a better design for their bridges over rivers, Henry's genius for fact-finding found frequent use in the service of his country. For example, he was appointed to the Lighthouse Board to help straighten out a bad situation in illumination and fog signals. When he got through, the United States had the world's best protective system for coastwise ocean traffic.

One of Henry's greatest projects at the Institution was the organization of a volunteer weather reporting service. He was the first to make weather forecasts from data obtained, to transmit weather reports, to indicate daily atmospheric conditions on a map and to



HENRY'S TELEGRAPH

In 1832, Henry strung 100 feet of wire around a room and transmitted electrical impulses through it to sound a bell. A steel bar, permanently magnetized and about 10 inches long, was supported on a pivot and placed with its north end between the two arms of a horseshoe magnet. When the latter was excited by current transmitted through the wire, that end of the bar was attracted by one arm of the horseshoe and repelled by the other. This caused it to move in a horizontal plane and the other end to strike the bell.

cover an entire continent with a single system. During a period of 30 years he laid the foundation of meteorological science. Thus, he fathered the U. S. Weather Bureau, which was eventually set up to take over the work he was carrying on. His report on *Meteorology and its Connection with Agriculture* was the first scientific treatment of the physics of the air in this country.

Under Henry, the Smithsonian Institution hewed close to the spirit of the Smithson will. He saw to it that the Institution not only stimulated the "increase of knowledge among men" but also took the lead in publishing scientific reports and distributing them to libraries and scientific bodies throughout the world. This put America in touch with what was going on everywhere, for it led to regular exchanges. During the Civil War, he directed the mobilization of scientific effort. For instance, a military hospital in Washington was in sore need of disinfectants. Henry put his staff to work in the laboratory and remedied the situation. He was the prime mover in the organization of the National Academy of Science, the Philosophical Society of Washington and the American Association for the Advancement of Science, which still maintains its headquarters at the Smithsonian.

At the request of the Navy, Professor Henry made a report on the best steel for ironclads. He also prepared a paper on the acoustics of government buildings. This served its purpose at the time and then gathered dust until, 70 years later, his findings had to be learned all over again to give wider scope to the high-fidelity phonograph, the radio and sound movies. For his investigations, all that he used in the way of instruments were a pair of hands to clap, a tuning fork and his own ears.

Henry became a close friend of President Lincoln who, he stated, was "science-minded." Lincoln liked to come to him for lucid explanations of physical facts, and once said of him: "I had the impression the Smithsonian was printing a great amount of useless information. Professor Henry has convinced me of my error. It must be a grand school if it produces such thinkers as he. He is one of the pleasantest men I have ever met; so unassuming, simple and sincere. I wish we had a few thousand more such men."

Today, the United States does have thousands of men of like dedication to science, and that is partly attributable to the influence Henry exerted as Secretary of the Smithsonian Institution which gave this country its first rallying center for scientists and rewarded their labors by publicizing their achievements.

Sulphite Liquor Good Gravel Binder

WHAT to do with sulphite liquor from pulpwood mills has long been a problem since most states now prohibit dumping it in waterways and polluting them. In Wisconsin, Brown County has found an answer to it by utilizing the waste product as a binder on unimproved roads. It is applied hot directly as it comes from the mill and serves to cement the gravel.

Whether used to provide a stable base for paving or directly on the roadway, the surface is first made smooth by a blade, and windrows of soil about 2 inches deep are built up along the edges to prevent the loss of liquor. The material is worked back into the roadbed immediately after pouring on the binder, which is applied at the rate of 18,000 gallons a mile in the case of an 18- to 20-foot traffic lane.

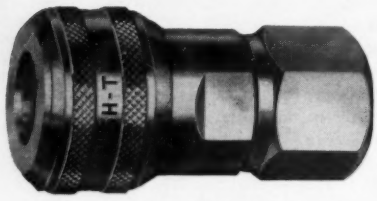
As rains leach out the sulphite solids in time, it is necessary to repeat the process at the end of a year, except in the case of heavily traveled roads which should be treated twice annually. However, as much of the binding effect survives the heavy winters, subsequent applications of sulphite liquor can be reduced, anywhere from 9000 to 15,000 gallons per mile sufficing, depending upon conditions. But it is in the building up of the bases of roadways that are eventually to be coated with asphalt that the erstwhile waste material promises to be of greatest service.

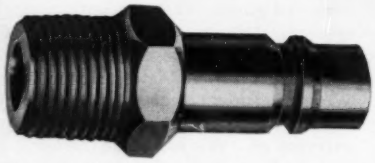
The Highway Commissioner of Brown County reports that sulphite-treated roads require much less replacement gravel and less grading than untreated roads to keep them in good condition and that the county's net annual saving as a result of the method has averaged $200 a mile.

Low Air Pressure?

THE RIGHT HOSE COUPLING CAN MAKE A DIFFERENCE

R. J. NEMMERS





FOR QUICK CHANGES

Where tools are changed frequently, a quick-connecting and disconnecting coupling at the tool is desirable. The half of the coupling on the hose line should provide means for automatically shutting off the air flow when the coupling is separated. The operator is shown assembling electrical-equipment components with a small Ingersoll-Rand screw driver. The tool is equipped with a Hansen Push-Tite coupling. The male half, left, is fastened directly to the tool, and the female socket, above, is on the hose.

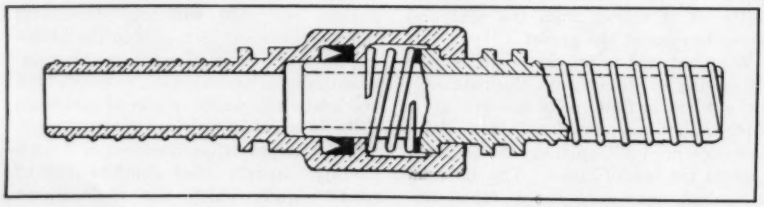
A POWER system can deliver only as much energy as its lowest-capacity segment or "weakest link" can carry. The reader is probably familiar with the penalties of inadequate home electrical circuits either vicariously or through personal experience. Compressed-air distribution systems, whether in a mine, an industrial plant or on a construction job, also are often inadequate and the users suffer accordingly.

A suitable installation is not necessarily an elaborate one. If it can supply all the air needed by all the tools on the line at the required pressure (usually 90 to 100 psi) and do it without excessive line losses it's O.K. To be most effective it should incorporate maintenance devices such as lubricators and water separators to protect tools and equipment. Hose couplings can be the "weak link" in an otherwise good system, but the right ones are easy to come by, and this article describes some of the things to look for in choosing them.

In home electrical circuits the lack of sufficient current-carrying capacity more often than not reveals itself in blown fuses. In a compressed-air system, however, no fuses burn out to call attention to low air pressure or insufficient volume. The only noticeable effect is diminished production and lowered efficiency. (One way to "fuse" an air line is to check it frequently with an air-pressure gauge.) But just as it serves no purpose to check for home-system deficiencies by measuring amperage and voltage at the generating station, taking the air pressure at the compressor does not give a true picture. It should be done by an air gauge at the place where the tool, hoist, etc., is used and while it is operating under full load.

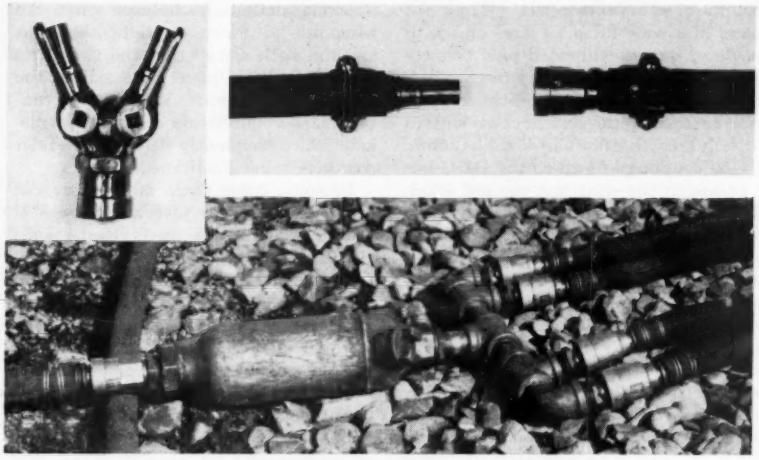
Naturally, because it is necessary to have the specified air pressure available at the point of application to get maximum performance from a modern air tool, the first thing to do in choosing couplings and fittings is to make sure that the air passages are of correct size and design. All the other features of any hose coupling are of secondary concern. Air passages should be straight-through and smooth to reduce pressure drop to a minimum and should be of sufficient diameter to carry all the air needed by the tool when running under full load.

Leakage of air causes pressure drop, thus lowering tool efficiency. The next thing to look for in hose couplings, then, is tightness under pressure. If gaskets are used they should be easily replaceable in the shop, mine, or field; if not, the mating surfaces should be large enough so that scratches and ordinary wear do not affect the seal. Proper installation of couplings is extremely important in preventing air leakage. The frequently observed practice of simply winding a few turns of wire around a hose can waste a lot of air; besides, it is unsafe. Properly applied wire or met-



EASILY CONNECTED

Cross section of an Ingersoll-Rand Type A coupling that is extensively used for hose lines serving pneumatic tools. The two halves are joined by pushing them together, and a spring holds them tight. The solid black sections with white triangles in them represent a gasket.



FOR SEVERE SERVICE

Wherever tools require moderate amounts of air and service conditions are more severe than those on small-parts assembly lines, most operators select couplings of the type illustrated. The manifold, lower picture, supplies air to four tie tampers and is equipped with four male sockets. Left of it is a lubricator that has a female socket at the air inlet (left end). The couplings are made by Ingersoll-Rand Company. Note the correctly applied wire clamps. The same type of coupling is shown disconnected at the top-right. The "Y" fitting at the top-left has a plug valve on each branch and permits regulating the air supply to two different tools independently.

al-strap clamps on smaller sizes and full, bolted clamps on extra-large hose and couplings will more than pay for themselves in the long run.

A word of caution should be added here about oversize couplings. Hose that is forced onto too large a shank may be seriously weakened in consequence and develop leaks after only a short service period. The use of couplings and menders of the wrong diameter can readily be prevented by maintaining an ample stock of all necessary sizes. Inventories can be reduced simply by standardizing on a few hose sizes. Ordinarily, a range of three or four is adequate for most operations. However, one should not sacrifice performance by fitting a tool with too small a hose.

Different makes of couplings have applications in well-defined fields, and the remainder of this article will discuss some of the general types available and their fields of service. Those described are perhaps not the only ones that might be suitable for a given job, but they have proved to be economical and reliable in use.

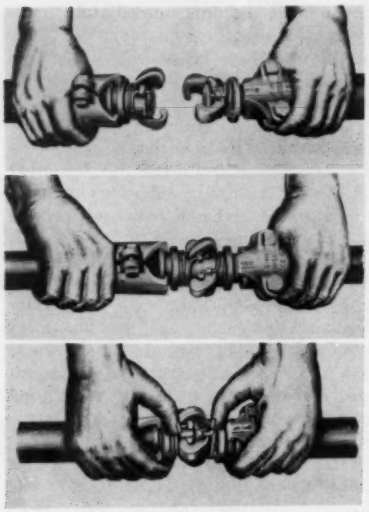
In industries with high production rates—automotive and home-appliance manufacturers, for example—many operations are intermittent and call for different tools that generally require only a low volume of air. Under these conditions, quick-connect and disconnect couplings are in order so that tools can be changed readily. In most cases provision is made for automatic shutoff of air flow when the coupling is parted. One suitable type of this kind, which is illustrated, is made up of a male plug and a female socket and is joined simply by forcing the two together. Separation is effected by pulling a sleeve on the female socket away from the male plug, a check valve on the female half shutting off the air flow immediately upon disconnection. This coupling has composition washers or gaskets as sealing faces. The washer fits in the female socket and can be easily replaced.

Tools that consume more air, such as those found in foundries, heavy metalworking plants and large-unit assembly lines, need a slightly different type that can withstand the more severe service and handle the greater volume of air required. One that answers the purpose is a positive locking device that will stay tight even when jerked or put under tension. The gasket seal does not intercept the flow of air, air passages are direct and smooth and the locking members can be renewed quickly when they become worn, as can the gasket.

The coupling consists of two components—male and female—which are joined by making a quarter-turn as the halves are pushed together. For special applications, it is available with either outside pipe connections or ribbed shanks on both male and female parts. It can also be furnished in "Y" shape with a wide variety of main stem and branch sizes, thus enabling two tools to be supplied with air through short light whips from one larger-diameter leader. Or the "Y" fitting can be furnished with valves on the two branches so as to regulate the air fed to either of the tools being used. In addition, the ½- and ¾-inch couplings are interchangeable; that is,

CHECKING AIR PRESSURE

With an Ingersoll-Rand Jackhamer undergoing a test, the man on the right uses a needle air-pressure gauge to make sure that the tool is getting enough air for optimum performance. (The needle gauge is inserted into the hose; when it is withdrawn the tiny hole seals itself and no leak results.) Inasmuch as drills and other air tools are designed to consume a given amount of air at a certain pressure, it is necessary that the user meet these conditions in order to obtain peak efficiency and power. Checking air lines frequently near the point of application and with the tool running under full load is a good idea.



UNIVERSAL COUPLINGS

These have grown popular because they can be used without regard to matching male and female parts: any half will couple with any other half of like size. Those pictured are Safety Lock couplings manufactured by Hose Accessories Company and equipped with a spring locking device that is positive and yet simple to operate. The two upper pictures show how the coupling is joined by bringing the two halves together with a quarter-turn. The lock springs into place automatically. To release the coupling, the springs are pulled back by the thumbs (bottom view).

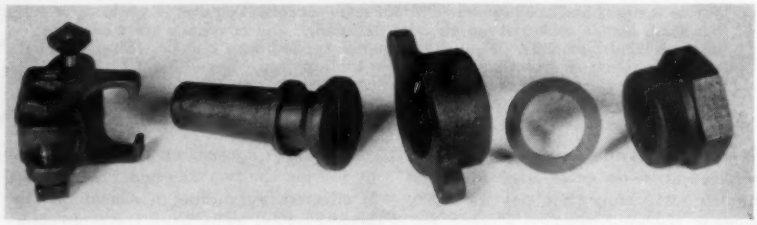
a male plug of either size may be mated directly with a female socket of the other size.

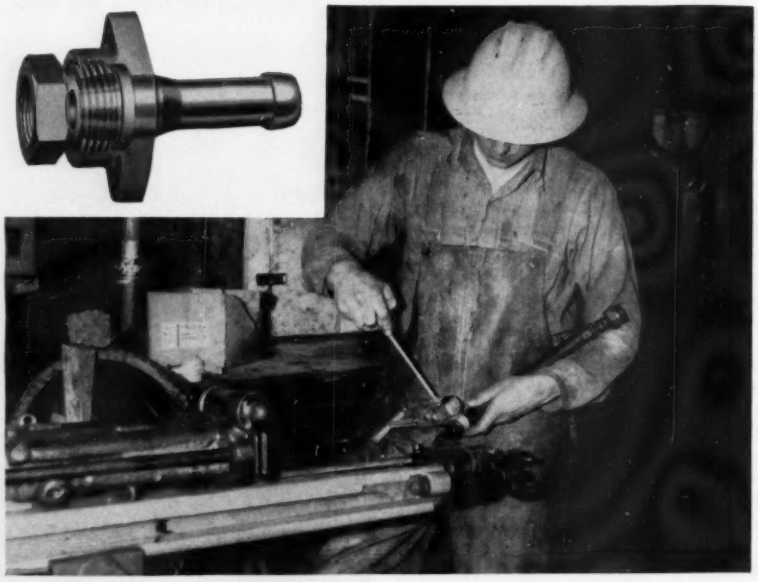
Another type that meets the general service conditions just described is known as the Safety Lock Universal Hose Coupling. It's chief advantage is that it has no male or female parts; any half will couple with any other half of the same size. The device is also positive locking (the locking spring can be renewed when worn or broken); is provided with inside or outside pipe threads as well as ribbed hose shanks; and has an easy-to-replace gasket on each half of it. "Y's" and 3-way and dead-end couplings for temporarily sealing off a hose or a port are available.

In mines, quarries and on construction jobs, hose and hose couplings undergo particularly harsh treatment. They are subjected to abrasion from being dragged over rough and broken rock, they are jerked and pulled and run over with heavy equipment—all in the interest of getting the job done fast. Furthermore, they are exposed to highly corrosive moisture conditions in many mines. Two types of couplings that have proved satisfactory for the service detailed are of wing nut-spud construction with specially designed coarse V-threads to insure rapid take-up and to lessen the possibility of crossed threads. They are made in a wide range of sizes and with inside or outside threaded pipe connections or hose shanks, as may be required. Wing nuts are malleable castings which can be drawn up and locked with a wrench or with a few blows of a hammer.

One coupling known as the RDC has a gasket in the wing nut against which the spud is seated and which is readily replaced in the field. Another, the DHC, uses no gasket; instead it is of taper-joint design in which a tapered male end mates with a matching female socket or spud. The male taper is enclosed in and protected by the wing nut. The area of the mating surface is large enough so that minor scratches and ordinary wear and tear have no effect on the perfect seal obtained by this type of construction. It is an exceptionally long-lived joint because it needs no soft, fast-wearing, easily dented seat. Moreover it is unusually safe, because when the wing nut is drawn up tight the joint locks in such a way that the two parts become one rigid piece, thus making the joint vibration proof. An added advantage is the elimination of changing gaskets which frequently deteriorate under corrosive mine conditions.

In some cases there is no clear cut dividing line as to just which type of coupling should be used. Under such circumstances experience is the best teacher, and coupling manufacturers and makers of pneumatic tools are always ready to share their's with operators. To sum up: the full benefits and cost savings possible with air power cannot be realized on any job unless the distribution system is as efficient and dependable as are modern air compressors and pneumatic tools. Couplings need not be the "weak link" in an otherwise adequate system.





PUTTING THEM ON TO STAY

Properly applied hose clamps reduce waste of air and protect operators from wildly whipping loose lines caused by fittings blowing off. A "drill doctor" is shown preparing an Ingersoll-Rand DB-35 drifter for operation by applying a Punch Lok hose clamp to the line leading to the air-feed motor. For extra large hose many operators prefer a bolted type of clamp. Couplings used in mines and on construction jobs take quite a beating from being dragged across broken rock, from corrosive water and from general abuse. Pictured are couplings built to withstand such conditions. The RDC, top, has a gasket, but the other one, center-left, needs none because of its tapered plug and socket. Both types have heavy malleable wing nuts that permit them to be tightened with a hammer or mallet as well as with a wrench.

This and That

Spare Tire May Save a Life

The B. F. Goodrich Company is publicizing the possibilities of using the spare tire in the family automobile for rescuing drowning persons. It is pointed out that many tragedies that occur in the water each year could be averted if people would realize that they have a first class life-saving tool within easy reach. Water demonstrations by police and safety groups have, it is claimed, shown that a spare tire, wheel and all, can support up to six persons safely in the water.

"Even a person who cannot swim," the announcement says, "can easily push a tire out to a person struggling in the water. The rescuer can keep the tire between himself and the person in distress, thereby keeping himself out of grasping range. What's more, the spare tire can be equally effective in winter to rescue persons falling through the ice.

"The spare tire's value as a life preserver may soon lead auto manufacturers to provide assemblies for cars that can be released in a few seconds with little effort."

★ ★ ★

Will Honor Roebling

Sometime before the end of the year, engineers will gather at the historic suspension bridge across the Ohio River at Wheeling, W. Va., to dedicate a bronze tablet and pay homage to the ingenuity and skill of John A. Roebling, best known for designing the Brooklyn Bridge.

Mr. Roebling didn't originate the Wheeling structure, but he did rebuild it in such a manner that it is still in service after an even hundred years. It was designed and built by Charles Ellet, a contemporary of Roebling and a fellow exponent of the suspension type of bridge. Ellet had previously designed and erected the nation's first suspension bridge, a 358-foot span across the Schuylkill River in Philadelphia, in 1841-42. It was supported by wire cables, five to a side.

The Wheeling structure, which was the first long-span suspension bridge in America or anywhere else, was designed and built by Ellet in 1846-48 with a span of 1010 feet and a roadway carried 97 feet above the water by six wire cables on a side. Each cable was composed of 6600 wires. The bridge was destroyed in 1854 and Roebling was called in to repair it and strengthen it.

To quote from *Bridges and Their Builders*, by David B. Steinman, one of our foremost modern bridge engineers, "the difference between Ellet's and Roebling's method of fashioning wire cables is well exemplified by this bridge. Ellet laid his wires in separate strands side by side, then connected these parallel strands by iron bars from which he hung the suspenders. Roebling squeezed his strands together to form compact cables of cylindrical shape, then wrapped the cables with light wire, hanging the suspenders from iron clamps that encircled the cable. Roebling's method provided improved protection for the wire from the weather, greater unity and strength for the cable, and a better means for fastening the suspenders."

Plans for the memorial rites at the bridge are being fostered by the Wheeling chapter of the West Virginia Society of Professional Engineers. The tablet will be provided by John A. Roebling's Sons Corporation, of Trenton, N. J. Repairs needed to keep the bridge in service are now in progress and the memorial ceremony will be held soon after they are completed.

"It's a good thing Hank has water on the knee or we'd never find him under this cave-in."

★ ★ ★

Workers Study Report

Two thousand employes of Youngstown Sheet & Tube Company in Youngstown, Ohio, and Chicago, Ill., recently attended classes arranged to explain the firm's 1954 annual report in detail. The sessions were opened with a recorded introduction by the company's president, after which thoroughly drilled instructors then went over the report to amplify the review of the year's operations and interpret the financial figures. The object of the meetings is to increase the interest of the workers in company problems and fortunes and thereby bring about better teamwork that will result in greater efficiency and lower production costs. This is the fourth year that the classes have been held.

★ ★ ★

Air On the Farm

The Prairie Farmer, published in Chicago, Ill., reports that an air compressor has so many uses on the farm that it will often pay for itself in a short time. Many farmers, for example, customarily let some of the air out of their tractor tires to obtain better ground-gripping action when doing heavy field work. If a compressor is available, the tires can be pumped up to normal pressure as soon as the work is completed; otherwise the tractor may have to be driven to town for the air. This is generally postponed and meanwhile the weight of the vehicle may break down the sidewalls of the tires.

The other big use of compressed air on the average farm is reported to be for cleaning machinery. Greasy, dirt-covered tractors and other pieces of equipment can be easily spruced up by spraying on a nonflammable cleaning fluid, allowing it to remain for a while and then washing it off with water in warm weather or blowing it off with air at other times. Cleaning up machinery after each season of use protects the paint, makes maintenance easier and prolongs the service life.

★ ★ ★

Bomb Shelter Tested

Four hundred Swedish soldiers recently served as "guinea pigs" in an experiment designed to learn how civilians might fare in a deep underground bomb shelter with no outside air source. The rock-enclosed space having an area of but 660 square feet was sealed for twelve hours. No air was supplied besides the 22,200 cubic feet (only 55 cu-ft per man) that filled the room when the experiment started. This air was reactivated continually, the carbon dioxide being absorbed by chemicals, and was kept in circulation by fans. Because of the cramped quarters, many of the men rested on steel shelves. Towards the end of the period, when the temperature had risen from 59°F to 81°F, the air was cooled before recirculation. All of the men came out in excellent physical and mental condition.

Editorials

PAGING YOUNG MEN

THE Associated General Contractors of America (A.G.C.) has launched a nationwide program to increase the number of apprentices coming into the construction industry each year. We haven't been hearing much about apprentices in recent years, and the word has, in fact, lost virtually all of its former meaning. It is now little more than a convenient term for a learner.

The apprenticeship system was of course an adjunct of the gild system that flourished in Europe in the middle ages. The British parliament first took notice of it in an act passed in 1383, but there were apprentices for at least 100 years before that time. In those times gilds had the exclusive right to practice their crafts in their communities. To retain this control, they allowed each master craftsman to take in and train boys. The gilds prescribed the training routine, even to specifying the tools to be used and the manner of handling them. Common gilds included slaters, carpenters and armorers, but even barristers apprenticed themselves to the law. In all cases, there was a contract of some sort and the apprentice was paid little or nothing, but the one to whom he indentured himself was obligated to feed and clothe him.

In England the Statute of Laborers and Apprentices of 1563 decreed that an apprentice should serve seven years, or even longer if, after that period had expired, he was still not 24 years old. This law was intended to quell the rising undercurrent against the apprenticeship system. It came at a time when the gilds were beginning to lose some of their tight grip on the crafts. New crafts such as textiles, hardware and cutlery had sprung up in certain English industrial centers that were under manorial control and in them the gilds had nothing to say about employment conditions.

Apparently recognizing that there was danger of their breaking up and that one of the best ways of perpetuating themselves was to keep enlisting apprentices, the gilds sponsored recruiting campaigns, much as our armed forces do today. Many of these messages were in the form of rhymes and ballads. Life in the crafts was pictured as attractive and jolly and stories were circulated of apprentices marrying the master's daughter.

The gild system declined in England in the 18th century with the increase in machinery and the growth of the feeling that every man should have the right to follow any craft he might choose, whether or not he had first served an apprenticeship. Also, many of the non-gild employers were unwilling to spend the time and money required to train large numbers of apprentices. Then, too, the rising trade unions took a hand in the matter and endeavored to limit the number of apprentices and to outline the conditions of their employment.

The practice of binding one's self to a master for a protracted period never was accepted so extensively in the United States, and during World War I it was completely eliminated. There was no time then to train youths fully in any trade and with the armed services taking their quotas, there were few able bodied youths to train. It was then that industrialists got the idea of breaking manufacturing processes down into a series of simple operations that any intelligent person could learn quickly.

There was a mild revival during the depths of the depression of the 1930's but only the larger concerns could afford the luxury of having low-producing workers on the payroll and there was certainly no shortage of adult wage earners. The comparatively small amount of youth-training that was done was merely a gesture on the part of the sponsoring firms to do whatever they could to keep boys from becoming derelicts.

The Associated General Contractors manifestly doesn't expect that it can get young men to bind themselves for long periods at low wages to learn the business. It does believe though that by spreading the word among the younger generation about the nature of the work and the opportunities it offers for financial rewards it can prevail upon boys of high school age to cast their lots with the construction industry either before or after a college course.

The need for filling out the ranks arises from the continuing growth of the country and the almost unbelievable pace registered by of all types of building with no signs of a slow down. A lot of economists are predicting a nation of 200 millions by 1970 and the A.G.C. says this will require one-third more construction each year than is now being recorded. The outlook is in fact so rosy that the rewards to be won by newcomers may perhaps be even more satisfying than marrying the boss's daughter.

BACK TO FUNDAMENTALS

WHEN professional golfers suddenly "go sour" and get "off their game," they usually seek the reason for losing their touch by going back to fundamentals. These men who depend upon their prowess in the links game for a livelihood return to day-long practice sessions in which they do the simple things over and over, like beginners. They study every motion at great length and search painstakingly for a clew to what they are doing wrong. If they still can't locate the trouble they may then go to another "pro" and take a lesson.

A leading business concern, Minneapolis-Honeywell Regulator Company, is adopting somewhat similar tactics in an effort to get some of its Philadelphia office workers "back on their game." It is enabling them to return to school and refresh themselves on how to do basic things right. The fundamentals of education used to be reading, writing and arithmetic, but the last one of the three has lost some of its force because most business calculations are now performed by machines. It is accordingly being ruled out in this instance.

However, before figures can be fed into a machine, they must be written accurately and then recognized correctly by the machine operators. Consequently, one of the courses being offered to M-H employees has to do with these requisites. Its object is to improve the speed, accuracy and legibility of seeing and recording numbers. The first 7-weeks' session of instruction produced an average increase of 20 percent in the speed of recognizing numbers, plus a 9 percent improvement in accuracy and a 6-percent gain in the legibility of the penmanship.

Before receiving instruction, most workers could see and copy a series of ten numbers containing from four to six figures each with 80 percent accuracy at a rate of one-tenth of a second per figure. After completing the class work, they were able to maintain the same accuracy, at the increased speed of recognition of one-hundredth second per figure.

As a new fundamental to take the place of figuring, the company has substituted listening and is offering courses to make its employes better listeners. According to the training director, C. L. Scheetz, careful listening is vitally important in today's business world. He declares that the so-called Atomic Age is still a world of words. He estimates that 70 percent of our time is devoted to communication. He claims listening consumes 45 percent of this, talking 35 percent, reading 16 percent and writing 4 percent.

It is important then that people listen correctly, but few of them do. Most of them only half listen, according to Mr. Scheetz. They allow their minds to race ahead of the speaker—up to four times as fast as a person talks—while fooling themselves into thinking they are following the conversation. The secret is to learn how to concentrate and that is what is being taught. About 100 employes are enrolled—including women.

Flour Packaged For Better Storage

by use of semirigid container and pneumatic baler

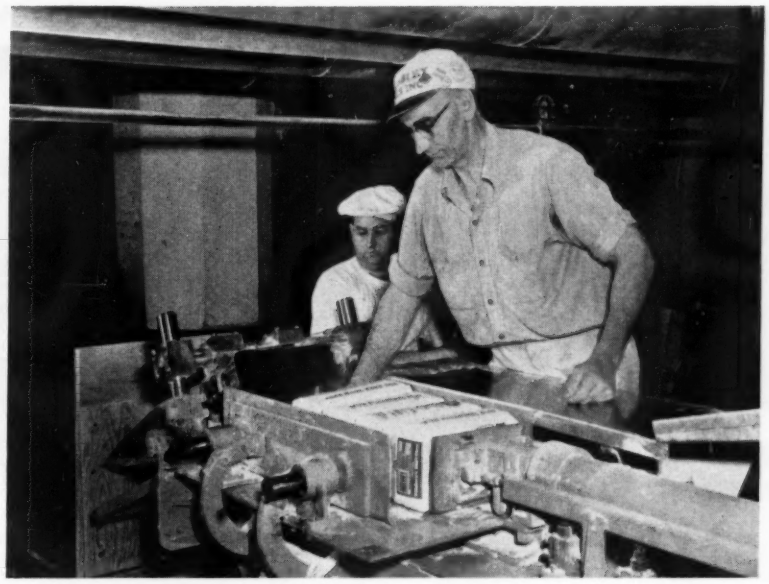
THROUGH the development of a new packaging system that is based on a semirigid container and special automatic equipment, the St. Regis Paper Company benefits everybody through whose hands flour and cornmeal have to pass on their way to market. As normally shipped, family-size bags are limp and soon become irregular in shape, making it difficult to pile them on grocers' shelves or high in storage.

The container is made from a single ply of heavy-duty Kraft paper and serves the same purpose as a corrugated carton but takes up less space. At present there are four standard sizes holding, respectively, twenty-five 2-pound, ten 5-pound, five 10-pound and two 25-pound bags, or 50 pounds apiece. Under the latest system of packaging each lot is delivered by chute to the operator of an air-powered baling machine who places the sacks in a prescribed pattern in a magazine—the number determining the arrangement. But before he does that he puts one of the semirigid containers on duck bills or guiding units that hold it open to receive the bags.

The baler is controlled by push button and, together with a number of conveyors, a sealer and a spray gun, is automatic in its action. When the magazine is loaded, the sacks are compressed and squared up between a stationary and a movable plate attached to the piston of a pneumatic ram. Simultaneously, the duck bills open and a hinged table swings up into horizontal position to support the container during filling, which is also done by the air-powered ram. The latter then retracts, the table drops back in place and the cycle is repeated. Meanwhile the package moves on to a short settling conveyor which is driven by a shaft mounting a ball-bearing eccentric connected to a shaker plate. Adjustable oscillating sideboards hold it upright, and by the time it reaches the end of the 27-inch platform it may be as much as an inch shorter than it was at the starting point.

Next, the package is delivered by conveyor belt to the indexing mechanism of a standard Ferguson case sealer which has been converted by a special kit of parts designed for the purpose by St. Regis. Top and bottom guide rails hold it erect as it and the succeeding bags are spotted in timed sequence under the flap folders and spray gun. At the right instant the latter applies glue in a fine mist to the side flap that goes down last. Finally, a tight, dry seal is effected by further compression and drying. The total elapsed time from the start of baling until the now rigid package slides down a chute to a pallet loading platform is said to be less than two minutes.

Under existing conditions the bags are stacked and arranged in the magazine by hand, but company engineers have designed an automatic feeder for the baler. With that in service, the sole function of the operator will be to put the empty containers on the duck bills and he will be able to pack up to eight 50-pound containers a minute. So far the system has been used to bale only flour and cornmeal, but it is applicable to other products of a similar nature.



LOADING THE MAGAZINE

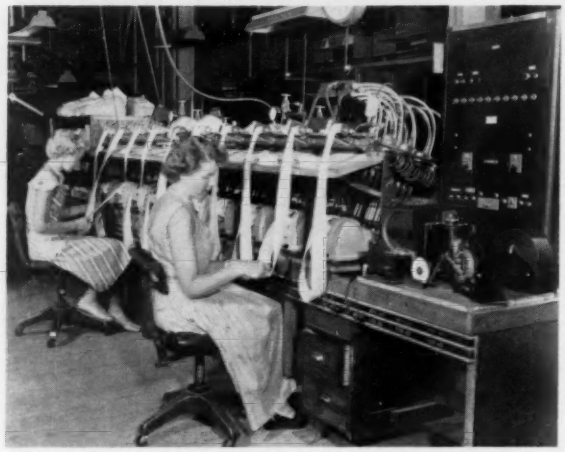
The operator has arranged four 10-pound bags of flour in the prescribed baling pattern in the magazine and is awaiting the fifth to complete the load. They slide onto the table in front of him from an inclined chute, the lower end of which is seen at the extreme right. Beneath it is the air-powered ram that compresses the packages and then pushes them into the semirigid container. The latter, held open by the duck bills, is at the far end of the machine with the hinged table in the down position in back of it. The flattened rigid packages can be piled high in warehouses without becoming deformed, as the picture at the left shows. Because of the double wrap there is also less danger of breakage and loss of flour.

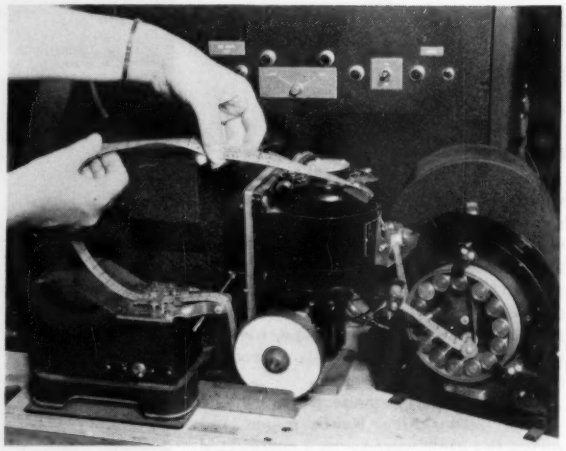
Foam and Cement Make Cellular Concrete

A FOAMY aerated mass, much like that now extensively used to extinguish fires, is being mixed with cement to make cellular concrete. The process, developed by National Foam System, Inc., West Chester, Pa., has been tried apparently with success in building the big Sears, Roebuck & Company retail store in Philadelphia, Pa. On the roof of that structure, which has an area of 60,000 square feet, there is a 3-foot-thick insulating fill of the material, which was mixed and poured at the rate of 15 cubic yards an hour.

Called the National-Crete System, the foam consists of a protein-base compound to which clean water is added in a premix tank from which it is forced by compressed air through a nozzle into an end-loaded transit mixer containing a slurry of cement and water. The nozzle is preset to deliver 60-120 gpm of foam, depending on the size of the batch and the density of the concrete. That poured on the Sears roof was maintained at 40 pounds per cubic foot and necessitated the use of approximately 130 gallons of foam per cubic yard. It is reported that the mix is easy to handle and flows readily into all parts of an intricate form because the foam likewise serves as a lubricant.

Pneumatic Fingers Do the Work





TEN-MACHINE TEST SETUP

As the adding machines come from the assembly line they are automatically tested in groups, as pictured at the left. This enables the two inspectors to give their entire attention to the tapes printed by the machines, proofreading them for errors and mechanical defects. Note the multiplicity of hose connections and air cylinders, each ⅜ inch in diameter, that depress the keys of the machines on the worktable in front of the girls. At the near end is the mechanism, also shown close-up in the other view, that controls the operation of the test unit. The endless paper tape is punched with about ten tests in coded form.

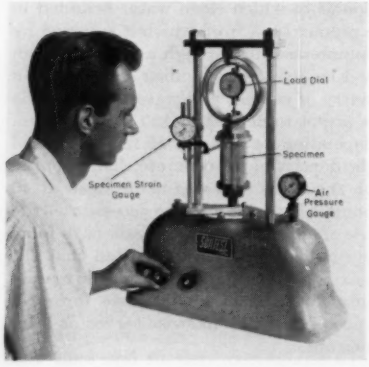
FINAL inspection of Burroughs Corporation's high-speed electric 10-key adding machines has become an entirely automatic operation through the development of an ingenious pneumatic test unit that responds to coded instructions punched in paper tape. The equipment was designed and built by company research engineers and is said to put the machines through a much more rigorous workout than they would ever receive in service and in far less time than by the older method.

Called "commercial inspection" in the plant, it makes it possible to test ten adding machines simultaneously. In place of human fingers there are tiny pneumatic cylinders, eighteen for each machine, which start to function when the tape, in the form of an endless belt, passes through a control cabinet containing banks of relays and stepping switches that actuate solenoid air valves. These release air at 6 to 20 ounces pressure to push down the pistons which depress the keys. The air is taken from a shop line and fed to the cylinders through multiple hose connections.

All the while testing is in progress, two women inspectors proofread the tapes from the ten adding machines for accuracy of totals, type defects, improper spacing and alignment and other imperfections. The equipment can also be used to run exhaustive endurance tests and can be modified, according to company production men, so that any business machine built by Burroughs can be given a similar workout without human aid. By use of it, ten machines are now being tested in the time it formerly took to check one.

Air-Powered Compression Tester

OF INTEREST to industry is a new portable compression tester that weighs only 35 pounds and enables compression and crushing tests to be made quickly, easily and accurately on widely varying materials and articles such as metal, ceramics, wood and plastics; paper boxes and other containers; soils, building and highway materials; and springs. Because of its portability it can be used in the field as well as on inspection lines and in laboratories. It is powered by compressed air acting through a 5-to-1 hydraulic booster. Compressed air permits imposing a constant rate of strain rather than the pulsating or fluctuating load resulting from the use of a manual pump.



The accompanying illustration shows the arrangement of the tester. Air enters it through the nipple on the air gauge. Turning the right-hand valve on the base of the unit feeds air into the booster; the left-hand valve controls the admission of hydraulic fluid to the loading piston. The load applied to the specimen is shown on the proving-ring dial and is determined by measuring the deflection of the calibrated rings. The outer ring is of low capacity for light loads; the inner ring is brought into action with heavier loads. The use of two rings permits taking advantage of the greater sensitivity of a lower-capacity ring without danger of overloading. Complete stress-strain analysis data may be obtained by successive readings of the load- and strain-gauge dials during a test. An important feature of the device makes it possible to release the load at any time during a test, or at the instant the specimen begins to fail, thus preserving it for further study.

The standard machine provides a maximum hydraulic pressure of 500 psi at 100 psi air pressure, although units with capacities up to 1000 psi are built to order. A lightweight air receiver with carrying handles is supplied for service in the field or in places where there is no regular air supply. The compression tester is manufactured by Soiltest, Inc., of Chicago, Ill., and is an adaptation of machines used for making large-scale soil tests.

QUOTES

—FROM HERE AND THERE

The Uncommon Man

"This country may need a good, five-cent cigar; but it could better use a hundred or so new millionaires—modern Edisons, Carnegies, Hills, Fords, Wanamakers. We need men of vision who'll build and produce—not little men who wish to divide and equalize. In this age of the so-called 'common man,' we desperately need a few uncommon men. . . .

"The honest effort of uncommon men to become millionaires created new sources of wealth. It didn't cost the rest of us a penny. On the contrary, the capitalistic millionaires created new jobs and paid high wages to the rest of us. It wasn't the pampered and glorified common man, but rather the defamed and slandered uncommon man, who put America on top of the world. . . .

"In reality, though, the future prosperity of everyone—including the needy—depends on *encouraging* persons to become millionaires; to build railroads, houses, and power plants; to develop television, plastics, and new uses for atomic power. The reason is simple: No man in a free country can make a million dollars through the machinery of production without producing something that we common men want at prices we're willing to pay. And no man will continue to produce something we want at a price we're willing to pay unless he has the *chance* to make a profit, to become rich—yes, even to become a millionaire."

From Wanted: More Millionaires, by Dean Russell

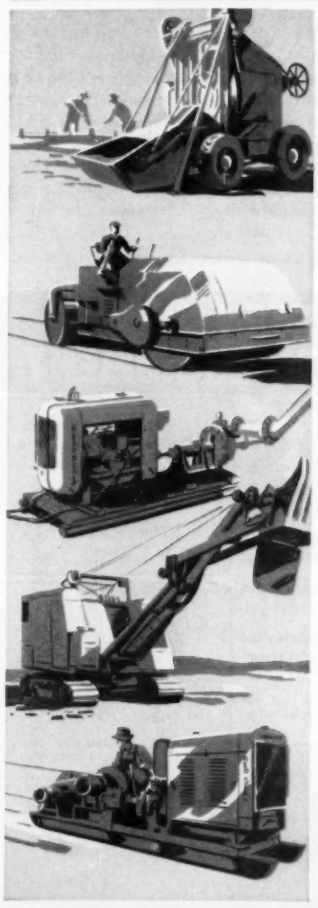
•

Pipe Lined with Plastic by Air

"Oil industry know-how has found a way to apply a coating of corrosion-resistant plastic paint to the inside of natural-gasoline pipe lines. First, a section of the pipe is disconnected and raised, cleared of entrapped liquids and gases, cleaned, rinsed with a solvent, and dried. When the liquid plastic is ready to be applied, two plugs are inserted into the line and the coating material metered in between them. Air is then applied to move the forward plug to the rear, squeezing the coating material until it fills the space between plugs. Then both plugs are started back slowly in the other direction by air pressure. Pressure is also maintained ahead of them to keep the space between plugs completely filled with paint, so that the pipe wall is uniformly coated. After this process, the line is opened, dried, and ready for service again."

Petroleum Newsnotes, May-June

Ingersoll-Rand GR-125 Compressor, supplying air for PB8 paving breakers. Power — Continental Red Seal F-162.



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Continental Red Seal power is saving money for owners of specialized equipment in all phases of the construction industry. You find Red Seals of varying sizes and specifications (14 to 237 horsepower—for operation on all standard fuels) in more and more leading makes of compressors, mixers, rollers, pumps, shovels, winches, and other machines at the job site. And you find them delivering their full work quota, with a minimum of down time, because each is engineered expressly for its job—built to do one thing and do it well.

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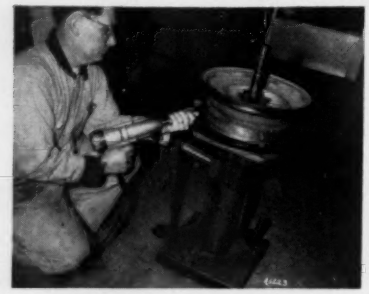
1252 OAKLEIGH DRIVE, EAST POINT (ATLANTA) GA.

Circle 14A on reply card

Industrial Notes

For applications where maximum power and speed are not required, Ingersoll-Rand Company has introduced a new size electric Impactool. Known as the 4U-SD, its structural features and impact mechanism are similar to those of



the heavy-duty model 5U. Weighing a little more than 6 pounds without the cable, the tool saves time and effort in service shops and stations and, by means of standard attachments provided for it in a handy kit, can be easily adapted from nut running to operations such as drilling, tapping, reaming, driving screws and studs, sawing holes, etc. Our picture shows the 4U-SD cleaning the rim of a tubeless tire with a wire brush.

Circle 1E on reply card

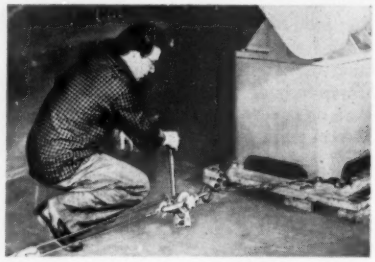
Automatic pencils with gold wire to do the scribing are used by an aircraft company in drawing master layouts on white-lacquered aluminum plates. It produces a sharp, black line accurate to within 0.005 inch. Though the wire costs 84 cents an inch, it's a money saver because it wears down less than an inch in twelve months.

A hinged electric heater, available in sizes to fit around 30- and 55-gallon drums containing viscous materials has been designed by Harold L. Palmer Company. Insulated with a 2-inch blanket of Fiberglas and controlled by a thermostat to prevent overheating, the unit is safe to use overnight, it is claimed, so contents will be sufficiently fluid for pouring when the workday begins.

Circle 2E on reply card

By use of an RCA electron microscope installed in its South District Filtration Plant, the City of Chicago is able to determine the effectiveness of its filtration and chlorinization processes in a matter of hours instead of days, as was formerly the case. The chemists use the instrument to detect the presence of bacteria in incubated water samples and with it obtain direct magnification up to 30,000 times. Then the size of the specimen can be enlarged as much as 200,000 times by taking photographs with an automatic camera built inside the microscope.

Strength and safety combined with light weight are properties of a hookup device manufactured by Wright Hoist Division of American Chain & Cable Company, Inc. Designated as the Type R Pull-A-Way, the unit is suitable for such jobs as moving motors and machinery, opening freight-car doors, stretching and holding tension supports, etc., and is reported to have demonstrated its sturdiness by setting a freight car in motion. Preformed, extra-flexible



wire hoist cable is used and wound on a 2-inch-diameter drum which, together with the sheave, handle frame and adjustment pawl, is made of Tenzaloy, an aluminum alloy of high tensile strength. Depending on whether the cable is single or double strand, it gives a pull or lift of 14 and 5½ feet, respectively. The hooks for anchoring the Pull-A-Way and securing the load are of steel. Safety features include double interlocking pawls, positive control through a notch-per-cycle letdown and a handle that will bend before any other part of the unit fails. The device weighs less than 9 pounds.

Circle 3E on reply card

Sheet-metal and woodworkers may find an improved form of parallel edge scriber a handy little tool. Made from cold-finished strip steel, it is graduated in sixteenths from ⅛ to 1 inch and is suitable for sheet stock such as metal, plastics and plywood. It can be obtained without cost by request on company

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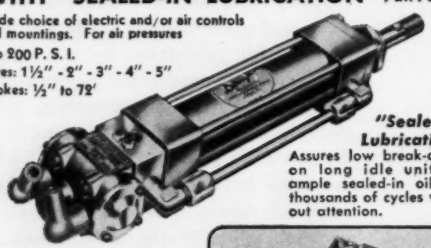

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Assures low break-away on long idle units — ample sealed-in oil for thousands of cycles without attention.

"Sealed-in Lubrication"
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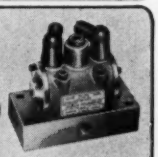

Air or electrically operated. J.I.C. Standards.

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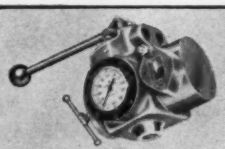
freely on all air automation or replacement problems. Trained factory personnel available nationally.
Write for Catalogs and Name of Nearest Lehigh Representative



COMBINATION VALVES
Panel units, hand and foot operated valves. Wide range of models.

Lehigh Minor AIR VALVES and CYLINDERS

Low priced, light duty. For air operated jigs, fixtures, high speed operations.

Lehigh INC.
ENGINEERS & MANUFACTURERS
1513 Lehigh Drive
EASTON, PENNA.

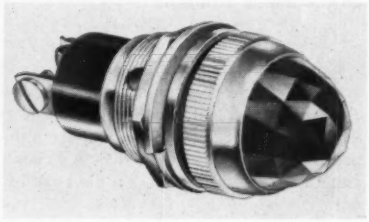
Circle 15A on reply card

letterhead sent to Dayton Rogers Manufacturing Company, 2824 Thirteenth Avenue South, Minneapolis 7, Minn.

Several advantages are claimed for a new plastering trowel made of flexible stainless steel. Of the same weight as the conventional tool, it is reported to be more resistant to staining, pitting, wear and corrosion. It is furnished in two sizes by Goldblatt Tool Company.

Circle 4E on reply card

Dialight Corporation is offering a new series of oiltight pilot or indicator lights for heavy-duty industrial applications. Of rugged construction, they are said to have a number of unusual features such as special provision for retained



oil-resistant gaskets; glass lenses in several shapes and in a full range of colors with omnidirectional light spread; disks with words, letters or numbers fitted behind flat glass lenses to deliver specific messages; and a wide range of incandescent bulbs with screw or bayonet base, as well as neon lamps. They are available for mounting in either a $1\frac{3}{16}$- or 1-inch clearance hole.

Circle 5E on reply card

At the annual meeting of the Technical Association of the Pulp and Paper Industry it was announced that Du Pont has succeeded in making paper from synthetic fibers such as nylon, orlon and dacron. It is reported to be ten times stronger than pulp or rag paper; highly resistant to chemical attack, molds, bacteria and light; and to absorb little moisture. These properties recommend it for many uses and products such as heavy-duty bags, filters for corrosive liquids, tracing paper, maps and permanent records and documents. Tests indicate that the paper can be produced commercially, and Du Pont, which is not going to manufacture it, is turning the details of its work over to the paper industry.

For the safety of maintenance men and others who are required to work in hazardous atmospheres, Acme Protection Equipment Company is offering a gas-mask kit that is designed to meet all requirements. The multipurpose outfit

Let WISCONSIN HEAVY-DUTY ENGINE POWER Carry the Load . . .

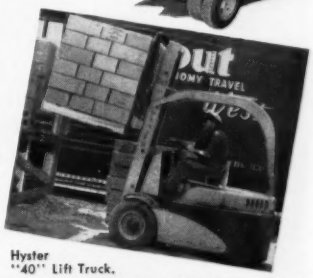
Whether handling bulk or packaged materials . . . on the loading dock, in the yard, plant or warehouse . . . you can depend on Wisconsin Heavy-Duty Air-Cooled Engines to carry the load with economy and efficiency.

When you specify "Wisconsin Power" for your material handling equipment, you are assured of dependable, heavy-duty "lugging power" that stays with the job. Carefully engineered heavy-duty design and construction and such features as tapered roller bearings at BOTH ends of the crankshaft, rotary type high tension OUTSIDE magneto with Impulse Coupling for easy starting in any weather at low cranking speeds, PLUS all-weather AIR-COOLING . . . these are some of the factors that contribute to stay-on-the-job dependability and long engine life.

Let Wisconsin Engines *carry the load* on *your* material handling equipment. A full range of sizes from 3 to 36 hp. provides the most complete power selectivity to fit both the *machine* and the *job*. Write for Bulletin S-164.

Model 3600 Kalamazoo tow tractor.

Prime Mover, made by Prime Mover Co., Muscatine, Ia.



Hyster "40" Lift Truck.

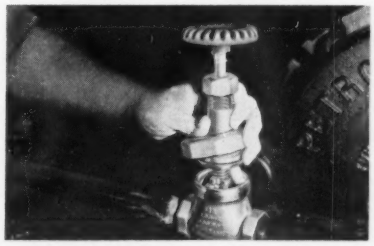
WISCONSIN MOTOR CORPORATION
World's Largest Builders of Heavy-Duty Air-Cooled Engines
MILWAUKEE 46, WISCONSIN

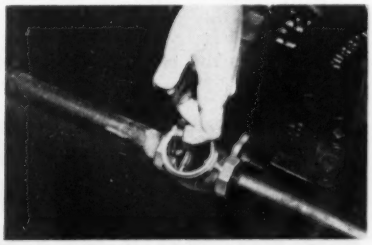
A 8221-1/3

Circle 16A on reply card

After two years of testing under severe service conditions ranging from steam to corrosive liquids, The Fairbanks Company has announced its bronze gate valve which is said to be the first of its kind that permits renewal of the seat ring without taking the valve off the line. Only an ordinary screw driver is required to effect the change, and replacements have been made in from seven to ten minutes from the time steam was shut off until it was turned on again, according to company reports. The outstanding feature of the design is that the angle of the pointed end of the retaining screw is complementary to the angle of the seat ring. The resultant line of contact holds the seat ring securely in place without excessive pressure on the screws. The latter are of silicon bronze which will not gall or freeze, and the fine-pitch threads obviate the possibility of their backing off in service.

Circle 6E on reply card





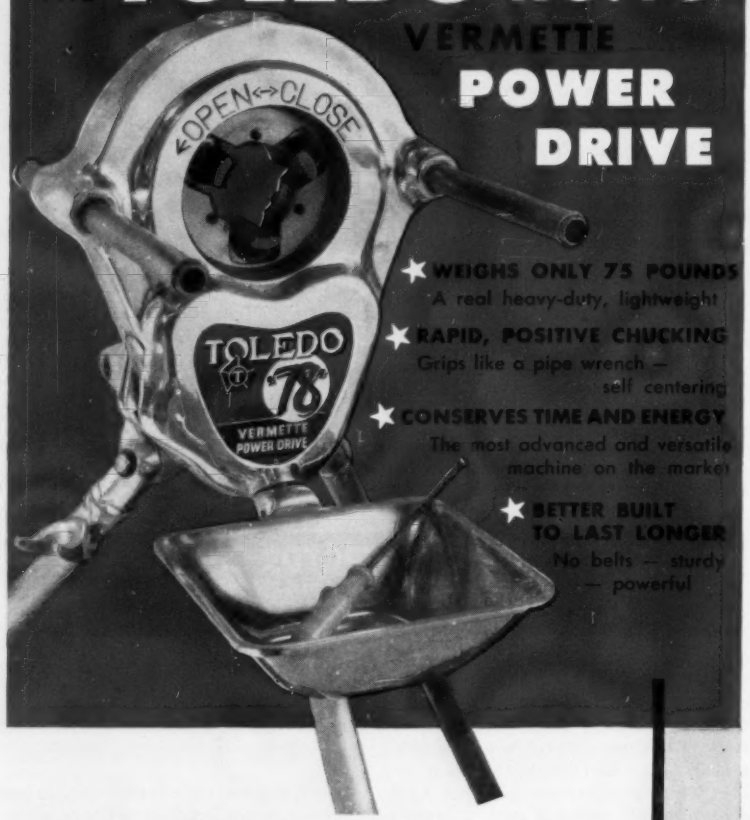
SEAT RING REPLACED WITH VALVE IN LINE

In the sequence in which they appear, the pictures show removal of bonnet from valve body, of retaining screw and of the seat ring. The operations are reversed in inserting a new seat ring and require only a screw driver.

It's Amazing!

THE **TOLEDO NO. 78**

VERMETTE POWER DRIVE



★ **WEIGHS ONLY 75 POUNDS**
A real heavy-duty, lightweight

★ **RAPID, POSITIVE CHUCKING**
Grips like a pipe wrench — self centering

★ **CONSERVES TIME AND ENERGY**
The most advanced and versatile machine on the market

★ **BETTER BUILT TO LAST LONGER**
No belts — sturdy — powerful

A time proved, PORTABLE power drive providing effortless cutting, threading and reaming of pipe and conduit . . . a worthy addition to "TOLEDO's" well known line of quality pipe tools. Fully guaranteed. Handles up to 2" sizes . . . grips, tightens and centers pipe automatically, forward or reverse. It's the lightest portable power drive of its kind. And remember . . . if it bears the "TOLEDO" label . . . you know it's a dependable product.

Write today for new free bulletin with conclusive proof of superiority. Your "TOLEDO" supplier has all the facts.

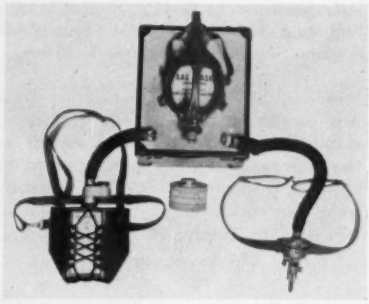
TOLEDO PIPE THREADING MACHINE COMPANY
TOLEDO 4, OHIO

BUILDERS OF THE WORLD'S FINEST PIPE TOOLS

TOLEDO®

PIPE THREADERS • PIPE WRENCHES • PIPE MACHINES

Circle 17A on reply card



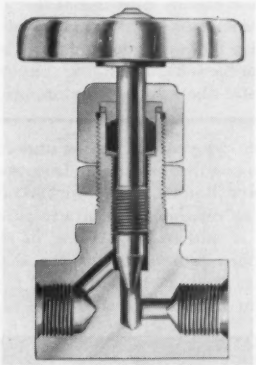
includes a full-vision face piece to keep out dust and smoke; a canister mask to prevent the inhalation of noxious gases and smoke from visible fires; and a mask supplied with compressed air for use in objectionable atmospheres.

Circle 7E on reply card

Cabs with power lifts to raise them vertically from their chassis to make the engine accessible for other than everyday servicing and maintenance are a departure in truck building. Mack Trucks, Inc., is responsible for the innovation, which is embodied in its Verti-Lift type ranging in gross weight from 20,000 to 28,000 pounds.

Circle 8E on reply card

In Republic Manufacturing Company's new high-pressure needle valve the body and stem guide are combined in a one-piece T-shaped stainless-steel forging. The result is a unit that cannot leak or come apart because there are no welds. Designed for a maximum working pressure of 10,000 psi and temperature of 200°F in water, gas, oil or vacuum service, it has successfully undergone proof tests of 25,000 psi. The semineedle stem has 40-pitch micrometer threads for metering and ease of turning. The valve is made with graphited-asbestos or Teflon packing and with female pipe-thread connections from ⅛ to ½ inch in size.



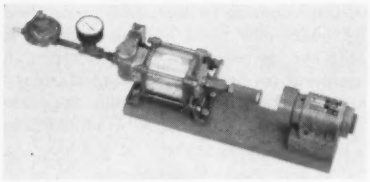
Circle 9E on reply card

Graphite bricks that are said to give up to 31 days service in a cupola well handling 350 to 450 tons a day are being

made by Mexico Refractories Company. They are formed in a dry press and are reported to be of uniform structure and to have low porosity with negligible shrinkage. The bricks are ready for laying with a graphite-base mortar.

Circle 10E on reply card

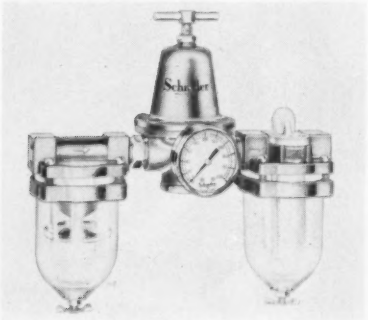
A positive displacement pump for liquid feed powered by a double-acting pneumatic cylinder has been developed by Hills-McCanna Company especially for application in the food-processing and other industries where air is preferable to electric drive because it permits accurate starting and stopping in intermittent or batch operations at either high or low pressure. A packaged unit mounted on a base and complete with a 4-way valve, it is ready for service when the air connection is made. The volume handled can be controlled by



adjusting the cylinder stroke or the operating speed. The UP reciprocating pump is available in four plunger sizes with capacities from 0.1 to 35 gph. The feed end is made of varying metals or plastics, depending on the liquid handled. Present uses range from introducing coloring, spices and preservatives into food products to pumping inhibitors and additives into petroleum products. One of the unusual applications is filling fountain pens with ink.

Circle 11E on reply card

Under the name Lub-air-ator, A. Schrader's Son has released to the trade an automatic combination air filter, regulator and lubricator for the protection of pneumatic tools, cylinders, valves, etc. The separator has a large-area sintered-bronze filter, a baffle plate and a drain cock for blowing out water and accumulations of foreign matter; the regulator adjusts the air flow from 250 psi inlet pressure to 5-125 psi; and the lubricator has a vibration-proof adjust-



SHORELINE EXPRESS

Dredging jobs run smoother when you use Naylor Spiralweld pipe. This distinctive pipe is light in weight for easy handling and installation, yet it has the extra strength, leaktightness and safety to withstand rough service. Combined with the Naylor one-piece Wedge-Lock coupling, it provides a most dependable line for getting materials where you want them in a hurry. For full details on Naylor pipe, fittings and couplings, ask for Bulletin No. 507.

NAYLOR PIPE

NAYLOR PIPE COMPANY

1245 East 92nd Street, Chicago 19, Illinois

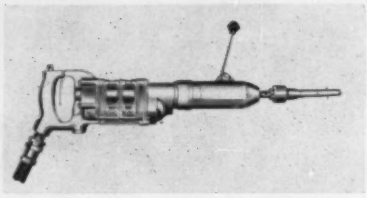
Eastern U. S. and Foreign Sales Office: 350 Madison Avenue, New York 17, New York

Circle 18A on reply card

ment thumb wheel that controls the oil feed from a steady flow down to intermittent drops, as needed. The transparent bowl holds a half pint and is refilled through a port with a special built-in sliding seal without shutting off the air supply. A sight feed enables operator to see if the oil is flowing in the prescribed quantity. The parts can be obtained separately or in pairs.

Circle 12E on reply card

Users of heat exchangers are often called upon to replace leaky or worn tubes which can, it is claimed, be quickly removed from the bundle by an internal



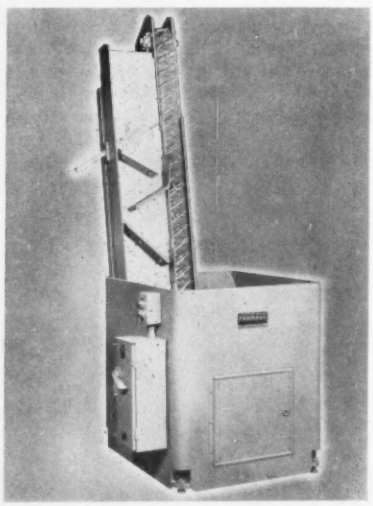
tube cutter of recent design. The tool has renewable double cutters, is powered by an air motor and controlled by a lever. It is inserted in the tube and cuts it off behind the tube sheet, the stubs remaining being knocked out by a special device. The tool can be adjusted for thicknesses from 1 inch to 4 inches and used on steel or nonferrous tubes from 5/8 to 1 inch outside diameter. According to a report of a recent demonstration, the cutter removed 280 one-inch Admiralty tubes of 14 gauge from an exhanger in 45 minutes.

Circle 13E on reply card

Quality of solder can be quickly analyzed, it is claimed, by a Tin-Content Indicator developed by Wheelco Instruments Division of Barber-Coleman Company in coöperation with Continental Can Company. The unit is designed for lead alloys containing up to 7 percent of tin and consists essentially of a portable, push-button controlled meter and of a lance-type sensing instrument with two cups: one in which a sample of lead is permanently sealed and an open cup into which is scooped a sample of the solder to be tested. The method by which the ratio of lead and tin is obtained is based on the difference in temperature between the lead standard and the lead-tin alloy while they are passing from a liquid to a solid state. The tin content is read on a scale.

Circle 14E on reply card

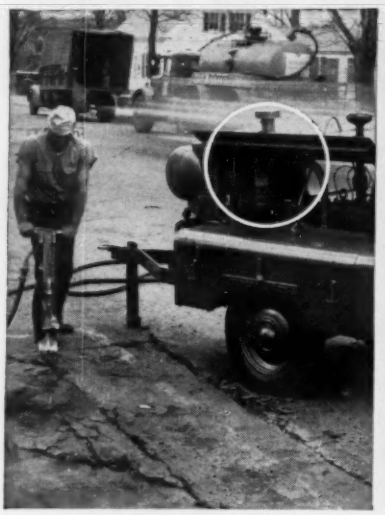
Hopper Feed No. 2200 is a new unit in the line of automatic feeders and conveyors made by Feedall, Inc. It is designed to handle rolling or sliding parts and to deliver them to a production machine at a rate of speed determined by the latter. The workpieces are picked up by cleats on a moving conveyor that extends to the bottom of the hopper, thus giving the feeder a variable loading height up to 36 inches. Point of discharge also is adjustable. Rolling parts handled range up to 3 inches in diameter and 1 inch long; sliding parts, 1 inch in diameter and 3 inches long. The hopper holds 4 cubic feet and the unit is driven by a ¼-hp variable-speed motor.



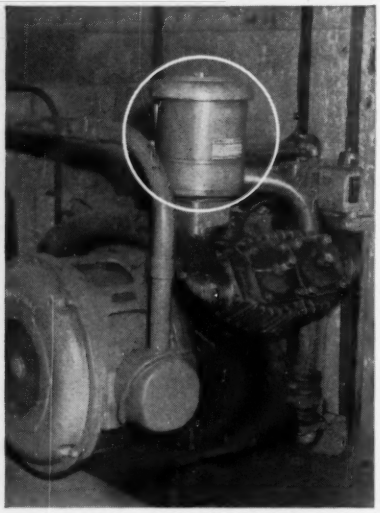
Circle 15E on reply card

Whether you dig trenches, or grease garbage trucks...

Air-Maze filters will keep your compressors on the go!



DESPITE FLYING DUST AND DIRT on this trench digging job, the mobile compressor stays on the go! Its Air-Maze oil bath filter scrubs intake air clean in a bath of oil—keeps airborne dirt from damaging polished pistons, rings and other vital compressor parts. An Air-Maze lube oil filter (not visible in photo) gives added protection against breakdown by filtering all the oil all the time.



TO GREASE ITS GARBAGE TRUCKS, New York Department of Sanitation uses air suppled by this compressor. And the air's there when they need it. An Air-Maze filter-silencer helps prevent breakdowns by keeping intake air clean. At the same time it dampens intake noise. Specify Air-Maze filters on the compressors *you* build or buy.

AIR-MAZE The Filter Engineers

AIR FILTERS • SILENCERS • SPARK ARRESTERS
LIQUID FILTERS • OIL SEPARATORS • GREASE FILTERS

25000 Miles Road • Cleveland 28, Ohio

Circle 19A on reply card

Books and Industrial Literature

Design Manual for High-Strength Steels is the title of a 174-page practical handbook published by United States Steel Corporation and written by H. Malcolm Priest, manager of the company's Railroad Research Bureau, and John A. Gilligan, senior technologist of its new Applied Research Laboratory. Prepared to fill a need resulting from the increasing application of this specific class of steels, it contains detailed technical information on the subject, together with formulas for high-strength as well as structural carbon steel and numerous nomographic charts that eliminate much of the time formerly spent in design calculations. These charts cover the complete range of stresses and can also be used to check design figures. Qualified engineers and architects can obtain a copy without cost by writing to U.S. Steel Corporation, 525 William Penn Place, Pittsburgh, Pa. Refer to publication ADVL-215-54.

Everything a company needs to organize a safety program, to instruct supervisors and to make and keep workers safety-minded is contained in National Safety Council's 1955 Occupational Safety Service Guide. It lists the wealth of material that is available on the subject in the form of newsletters, periodicals, a set of books that is a "must" for the safety man and 5-minute talks, as well as films, posters and decals covering every industry. The book also explains the services the Council renders to promote safety and its basic and advanced training courses for safety engineers. Individual copies of the 68-page Guide 2.1 can be obtained without charge from the Council at 425 N. Michigan Avenue, Chicago, Ill.

The R.P. Adams Company, Inc., has available an 8-page bulletin—No. 117—on its line of Poro-Stone compressed-air filters which effect separation in two stages.

Circle 16E on reply card

Product Examples is the self-explanatory title of a folder showing pictures of different forgings produced by National Forge & Ordnance Company. Each is accompanied by a legend describing its use.

Circle 17E on reply card

Catalogue No. 101 issued by Valcor Engineering Corporation illustrates and describes its SV-2700 floating seal solenoid valve—a new sanitary line with a "see-through" body for food and chemical industries and cup vending.

Circle 18E on reply card

Bulletin A-1308 describes The Carborundum Company's new Niagara line of masonry blades; lists types, sizes and applications; contains a comparative grade chart; and gives the key to its blade identification and ordering system.

Circle 19E on reply card

American LaFrance Corporation has compiled a 36-page booklet that gives detailed information about its fixed, portable and semiportable Foamite Airfoam equipment for fighting fires caused by flammable liquids of different kinds.

Circle 20E on reply card

Fischer & Porter Company has issued a 24-page catalogue—No. 2—that describes and illustrates all the standardized process-control instruments which it carries in stock in different parts of the United States for immediate shipment. The program was initiated several years ago to expedite delivery, especially in cases of emergency, to customers remote from the home plant.

Circle 21E on reply card

Grac, a lead-base babbitt metal containing graphite offered by Graphitized Alloys Corporation as a substitute for high tin-base babbitt, is described in a brochure obtainable upon request.

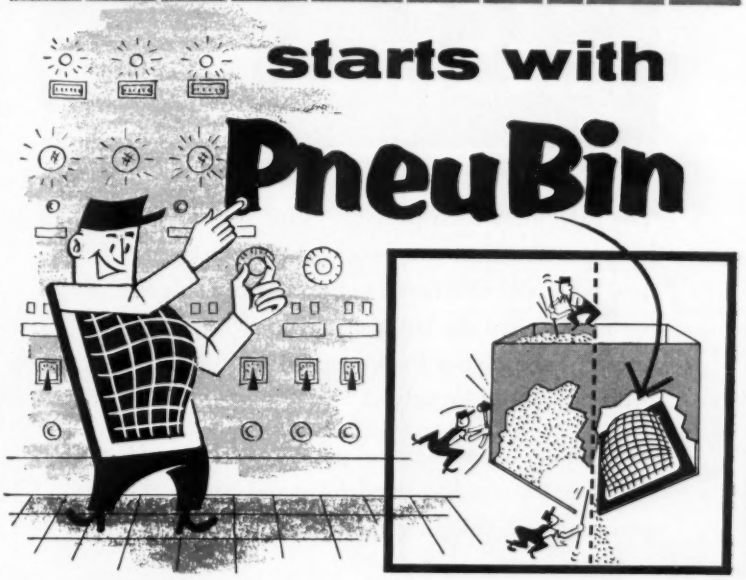
Circle 22E on reply card

Air filtration as practiced today in industry is discussed in a 20-page reference book and catalogue issued by Master Pneumatic, Inc., primarily with the engineer and purchasing agent in mind. It lists the many types of filters and lubricators made by the company, describes its new automatic Hydro-Jector and gives maintenance and installation data.

Circle 23E on reply card

To familiarize the nonmetallurgist with tool steels, Crucible Steel Company of America has published a 44-page booklet on the subject written in easily understandable language. Entitled *Tool Steels for the Non-Metallurgist*, it discusses the properties of the different grades in each of the six basic classifications and recommends in a general way the application for which each of the

AUTOMATION starts with PneuBin



Pulsating Panels assure constant material flow from bins and hoppers

Automation is an empty word if your production is interrupted by material hang-up in bins and hoppers. That all-important initial step of material introduction must move smoothly, flawlessly or the whole concept of automation is destroyed. PneuBin will solve your flow stoppage problems and reduce your operating expense. The PneuBin unit consists of steel-backed, neoprene, pulsating panels mounted on the inside walls of your present bins, and air controls to regulate the panels' action. By the pneumatic inflation of the PneuBin panels, the bin contents are positively displaced to insure free flow. Automatic inflation and deflation continues in cycles at whatever frequency is set on adjustable control. PneuBin operates off the regular plant air supply.

PneuBin decreases plant operating costs by reducing maintenance and adding to the life of your bins; insures constant material flow; and greatly increases personnel efficiency through its quiet operation.

Send for "Flow Stoppage Report" and FREE literature. PneuBin engineers will gladly make recommendations with no obligation on your part.

SOME FRANCHISED SALES TERRITORIES STILL AVAILABLE

PneuBin

A PRODUCT OF

GEROTOR MAY CORPORATION

1531 Maryland Ave., Baltimore 3, Maryland

Circle 20A on reply card

35,000 P.S.I. COMPRESSORS Sealed with FRANCE HYPER PACKINGS

The extremely high pressures now required by some chemical processes have created a new field for compressors and posed problems for mechanical packings considered impossible until France Hyper Packings proved these problems could be solved.

As builders of mechanical packings for nearly 60 years France has lived intimately with the problem of developing special packings for Industry.

The high degree of engineering and craftsmanship required for special service is reflected in the development and production of standard types of packings, piston rings and valve discs.

FRANCE

PACKING CO., PHILA. 15, PA.

Circle 21A on reply card

latter is best suited. Also included are information on heat treating and equipment and numerous conversion and other tables. Requests for copies should be sent to the company's Advertising Department, P. O. Box 88, Pittsburgh 30, Pa.

Standard and made-to-order industrial fastenings, hardware specialties and screw-machine products are illustrated and described in a folder released by Abbott Products, Inc., which is prepared to handle pilot as well as production runs.

Circle 24E on reply card

The Story of Willie Bacteria, or how to take care of your septic tank or cesspool, has been published for the benefit of the home owner by the Educational Division of the FX-Lab Company. The 8-page booklet is written in plain, entertaining style and is free of charge.

Circle 25E on reply card

A series of bulletins (Nos. 40 through 44) can be obtained from The Flexaust Company by anyone concerned with the design, installation or purchase of flexible hose used in dust and fume control, air conditioning and materials handling.

Circle 26E on reply card

More than 120 models of steel storage equipment such as racks, bins, shelves and pallet frames are listed in Frick-Gallagher Manufacturing Company's recently released illustrated Catalogue No. 702. It contains many helpful hints on space saving.

Circle 27E on reply card

Improved rollers of the dolly and swivel type for moving palletized loads on production lines, in warehouses and in loading and unloading operations are described in a leaflet prepared by Penco Engineering Company. They are heavy-duty units.

Circle 28E on reply card

Batavia Metal Products Corporation offers an illustrated 16-page bulletin, HW-B3, describing its line of levers and control units. Included is a photographic chart showing how special levers are assembled from standard forgings.

Circle 29E on reply card

High Pressure Equipment Company, Inc., which specializes in the manufacture of high-pressure valves, adaptors, reactors, autoclaves, thermocouplings, gauges, tubing and fittings has announced Catalogue 2055 listing and describing its products.

Circle 30E on reply card

A bulletin descriptive of its MST 6A1-4V titanium alloy has been printed by Mallory-Sharon Titanium Corporation. It enters into the metallurgy, chemistry and physical and mechanical properties of the metal and recommends heat-treatment, forging and welding procedures.

Circle 31E on reply card

Model EB Current Controller, a pneumatic-electric transducer that automatically controls current input as required in many industrial operations and processes, is described in Bulletin EB-1 obtainable from Conoflow Corporation. Operating features and typical applications are illustrated.

Circle 32E on reply card

Working data, uses and advantages of SAE Hydraulic Quality Tubing of low-carbon steel are set forth in Bulletin 39 prepared by Superior Tube Company. A 6-page folder, it contains a number of tables giving, among other information, a side-by-side comparison of four specifications suitable for pressure applications, recommended

maximum working and theoretical bursting pressures and minimum bend radii. There is also a velocity versus flow chart which makes it possible to determine the inside diameter of tubing for different hydraulic systems.

Circle 33E on reply card

Design features of Foster Wheeler Corporation's line of standardized steam generators are shown by simple line drawings and brief explanatory text in a folder now being distributed. Nine sizes with capacities from 50,000 to 150,000 pounds per hour are available, and pre-engineering permits quick delivery.

Circle 34E on reply card

An analysis of any filtration problem is offered by the Testing Division of Denver Equipment Company. This service is explained in its new Bulletin FG-B1, together with its disk, drum, pan, top-feed and laboratory filters for use in the metallurgical, chemical, coal, cement, sugar, paper and other industrial fields.

Circle 35E on reply card

Hewitt-Robins Incorporated is distributing Bulletin H-20 dealing with its molded rubber goods made to customers' specifications and with its industrial sheet packing. Included in the section on packing is a chart showing the hardness, tensile strength, elongation and other data on the ten types of pure-gum and synthetic-rubber sheet material available.

Circle 36E on reply card

Asbestos Textiles, a 16-page manual, has been compiled by Johns-Manville primarily for designers and purchasing agents of companies which incorporate its asbestos lap, roving, yarn, cloth, tubing, cord, wick, rope or tape in their products. Those who specify it for use where high ambient and operating temperatures prevail will also find the publication of value.

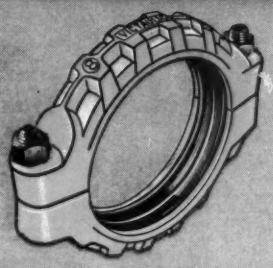
Circle 37E on reply card

Bulletin SS-55 has been prepared by Michigan Tool Company to give gear production men an informative picture of the operating features and advantages of two new Shear-Speed shapers—Models 18136 and 18206—recently added to its line. They are designed to cut gears up to 20 inches in diameter with a 6-inch face width. Facts about the basic Shear-Speed cutting principle are included in the brochure.

Circle 38E on reply card

"Get an old piece of baling wire and I'll have her perkin' in a jiffy".

VICTAULIC METHOD OF PIPING



VICTAULIC COUPLINGS

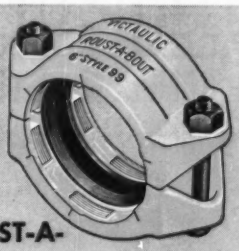
Styles 77, 77-D for standard applications. Simple, fast to install—sturdy and reliable. Sizes ¾" to 30". Style 75 Light-Weight Couplings for light duty applications. Sizes 2", 3", 4". Additional styles for cast iron, plastic and other pipes. Sizes through 60".

VICTAULIC FULL-FLOW FITTINGS

Complete line of Elbows, Tees, Reducers, Laterals, etc.—to fit all Victaulic Couplings. Streamlined for top efficiency, easy to install. Sizes ¾" to 12".

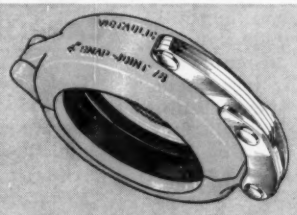
VIC-GROOVER TOOLS

Handy, on-the-job grooving tools that do the work in half the time. Light weight, easy to handle—operate manually or from any power drive. Automatic groove position and depth. Sizes ¾" to 8".



ROUST-A-BOUT COUPLINGS

Style 99 for plain or beveled end pipe. Best engineered, most useful plain end joint on the market. Simple, husky — easy and fast to install. Takes strong bull-dog grip on pipe. Sizes 2" to 8".



VICTAULIC SNAP-JOINTS

Victaulic's new boltless, speed coupling. — Style 78 — hinged into one assembly. Hand-locks for time and dollar savings. Sizes 1", 1¼", 2", 3", 4".

EASIEST WAY TO MAKE ENDS MEET

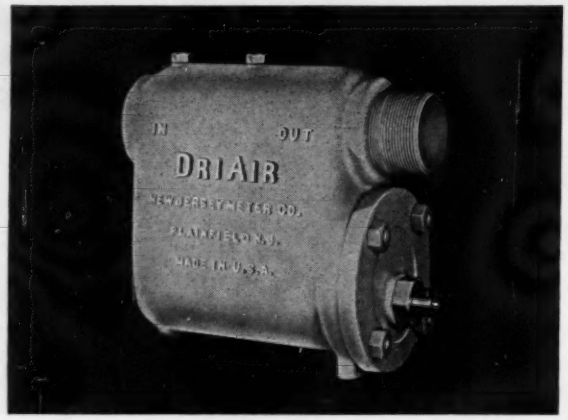
Promptly available from distributor stocks coast-to-coast. Write for NEW Victaulic Catalog-Manual 55-9B

VICTAULIC COMPANY OF AMERICA

P. O. Box 509 • Elizabeth, N. J.

Circle 22A on reply card

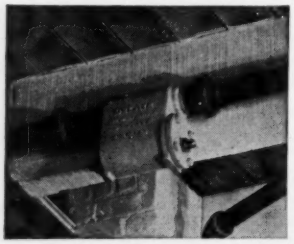
DEPENDABLE PNEUMATIC SERVICE



WHEN EQUIPMENT IS PROTECTED BY

DRIAIR

A COMPLETE SELF-CONTAINED UNIT



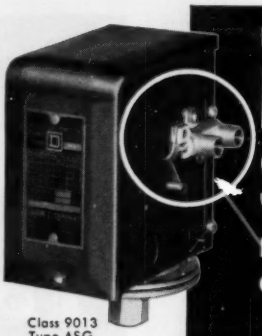
DriAir may be installed by suspending it from the piping, without any other support, or may stand on the floor near equipment being protected.

DRIAIR speeds production by separating and automatically ejecting the condensed water and oil from the air. DriAir collects dirt and rust from the air lines and delivers clean dry air to the tools, thus reducing wear and prolonging their life. All internal parts are made of bronze or copper—resistant to corrosion and practically permanent. Copy of Bulletin DA fully describing the operation of DriAir sent on request.

NEW JERSEY METER COMPANY

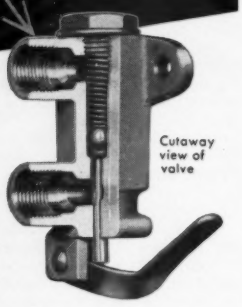
PLAINFIELD, NEW JERSEY

Circle 23A on reply card



Class 9013
Type ASG
Form X

HEAVY DUTY PRESSURE SWITCH FOR AIR COMPRESSORS



Cutaway view of valve

COMPLETE RANGE IN 1 CONTROL UNIT

Either 20 to 180 or 25 to 250 PSI. No spring changes required.

MORE AIR CAPACITY

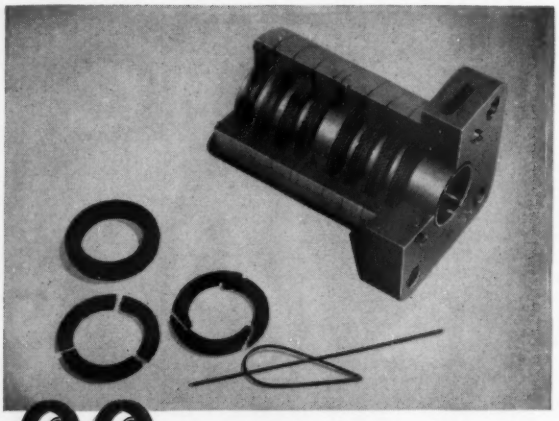
with improved 2-way ball and "O" ring type valve.

Write for Bulletin 9013A. Address Square D Company, 4041 N. Richards Street, Milwaukee 12, Wisconsin

ASK YOUR ELECTRICAL DISTRIBUTOR FOR SQUARE D PRODUCTS

SQUARE D COMPANY

Circle 24A on reply card



Look to COOK for Better CARBON PACKING RINGS!

Cook carbon packing rings are made of a special carbon graphite material that automatically assures you *high resistance to wear, chemical inertness and excellent heat conductivity.*

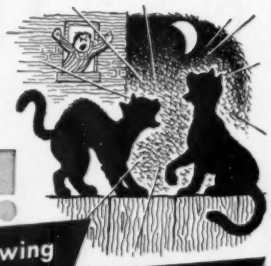
If you have sealing requirements for non-lubricated compressors, write today for a sample carbon ring, plus literature on Cook's complete line of packing materials. Address C. Lee Cook Manufacturing Co., 916 South Eighth Street, Louisville 3, Ky.

C. LEE COOK MANUFACTURING CO.

Sealing Pressures Since 1888

Circle 25A on reply card

STOP THAT NOISE!



we don't advise throwing

BURGESS-MANNING SNUBBERS

— at the cats, but we can assure you they will throw your annoying, costly and unnecessary intake and exhaust noises for a loss. Burgess-Manning Snubbers are designed to silence noise from air, steam and other gases being discharged into the atmosphere, or air intake of engines, compressors, blowers, etc. These noises can be very costly to you in disrupted and incorrect oral communications, jittery personnel, poor neighbor relations, and even in compensation claims for impaired hearing. Burgess-Manning Snubbers are engineered to your needs.

Tell us your problem — let us recommend

BURGESS-MANNING COMPANY

Sound Engineering

757 East Park Avenue, Libertyville, Illinois

Dallas, Texas

Circle 26A on reply card

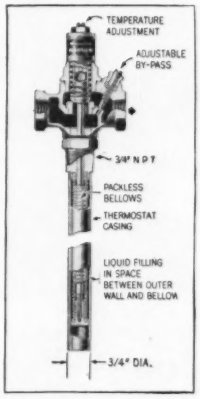
How to step up compressor performance

You know how *over-cooling* (1) causes condensation in cylinders which destroys lubricant, increases wear; (2) wastes water.

Under-cooling reduces compressor capacity—often damages cylinders, pistons, valves, seats.

You can easily avoid these costly troubles by equipping your compressors with simple, inexpensive Sarco self-powered cooling controls. They insure optimum cooling effect with minimum water consumption... regardless of variations in load, pressure, and supply water temperature.

Write for Handbook 520-A "Is Your Air Compressor Capacity Effective?"



SARCO T-44 COOLING CONTROL

Self-powered—requires no electrical or compressed air hook-up. Adjustable temperature ranges.

• • •

Inexpensive; less than $40

• • •

Complete Sarco line includes Cooling Controls with remote bulbs.

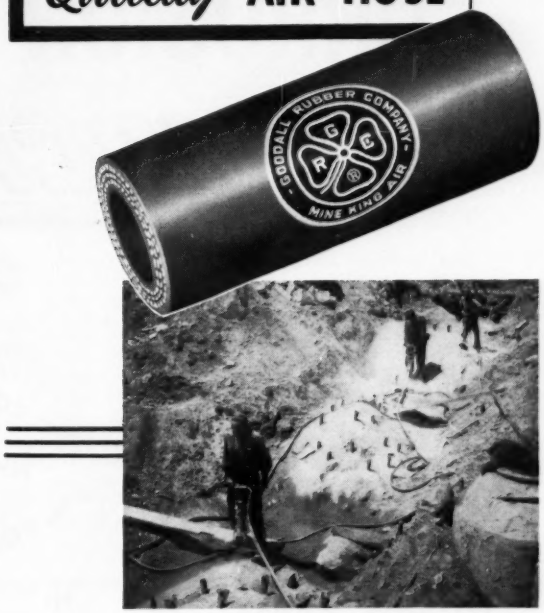
SARCO COMPANY, INC.

EMPIRE STATE BUILDING, N. Y. 1, N. Y.

2128-F

Circle 27A on reply card

WHEN TOUGH JOBS DEMAND A *Super-Quality* AIR HOSE



It Will Pay You to Specify

"MINE KING"

A GOODALL "STANDARD of QUALITY" PRODUCT

Whenever extremely severe service calls for an air hose of exceptional strength and stamina . . . in construction, mining or general industry . . . "MINE KING" is the answer. Its use will assure important savings in operating and replacement costs through convenience in handling, and punishment-defying durability.

Molded-and-braided construction, in lengths up to 500 feet-fewer intermediate connections required.

Tough, smooth brown rubber cover withstands severe abrasive wear; resists shock from falling rock, tools, timbers; prevents penetration of water into carcass.

Extremely flexible - easier to handle under cramped drilling conditions and when coiling for movement between locations. Sizes ½", ¾" and 1".

Contact Our Nearest Branch for Prices

GOODALL RUBBER COMPANY

Est. 1870

GENERAL OFFICES, MILLS and EXPORT DIVISION, TRENTON, N. J.

Branches: Philadelphia • New York • Boston • Pittsburgh • Indianapolis • Chicago • Detroit • St. Paul • Los Angeles • San Francisco • Seattle • Spokane • Portland • Salt Lake City • Denver • Houston • Goodall Rubber Company of Canada, Ltd., Toronto • Distributors in Other Principal Cities

Circle 28A on reply card

Only Ingersoll-Rand Chemical Pumps offer you the exceptional

CORROSION RESISTANCE

of IRCAMET

This special alloy steel, developed for chemical pumps, easily handles a wide range of corrosive solutions ...from sulphuric acid to caustic soda!

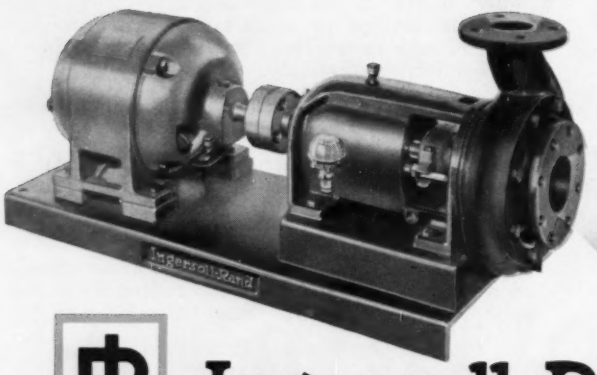
Na_2CO_3 NH_3 H_3PO_4 H_2SO_4 NaCl NaOH CH_3COOH

The ability of I-R chemical pumps to withstand such a wide range of strong corrosive solutions is the result of years of metallurgical research—both in the laboratory and in the field.

All parts of the pump that come in contact with the liquid are made of IRCAMET—a high nickel-chromium-molybdenum alloy steel, specially developed for chemical pump service.

The problem of *leakage*, too, has been successfully solved by a patented LEAKOLLECTOR stuffing box gland that completely encircles the shaft and stuffing box. In addition, all I-R chemical pumps can be supplied with a packless CAMERON SHAFT SEAL that requires practically no attention or maintenance.

These performance-proved I-R chemical pumps are available in sizes from ¼ to 125 hp, with capacities from 10 to 4000 gpm. For complete information, write for Bulletin No. 7095-A. Or if you have a pumping problem of any kind, just call your nearest Ingersoll-Rand representative. He will be glad to help you.



CH_3COOH NaOH NaCl NH_3 H_2SO_4 H_3BO_4 Na_2CO_3

Ingersoll-Rand

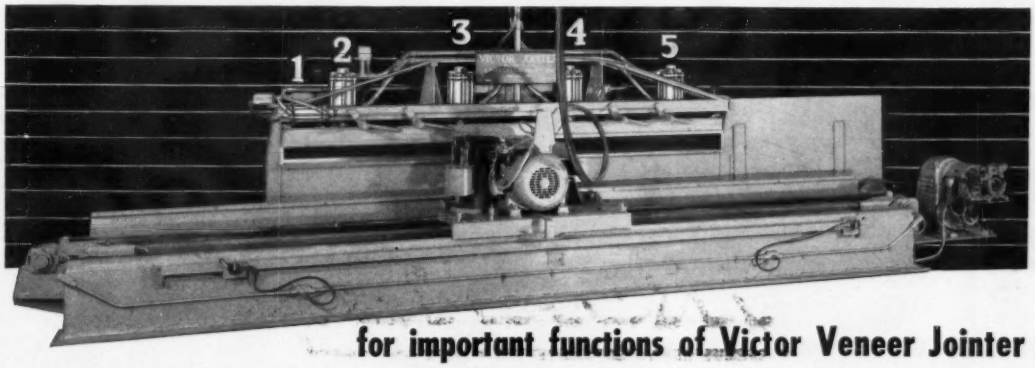
10-204

Cameron Pump Division
11 Broadway, New York 4, N. Y.

PUMPS • CONDENSERS • TURBO-BLOWERS • COMPRESSORS • AIR & ELECTRIC TOOLS • ROCK DRILLS

Circle 29A on reply card

5 NOPAK Cylinders supply pressure and pull



for important functions of Victor Veneer Jointer

The Victor Straight-Line Veneer Jointer, built by the E. V. Prentice Co., Portland, Ore., employs a NOPAK Model E 2½" x 6" Cylinder to operate the stops which align the stock, and 4 NOPAK Model D, 6" x 5" Cylinders to exert adequate, equalized clamping pressure on the full length of the stock to be joined. All cylinders are controlled from a single station to provide for fast precision alignment and clamping in a rapid, repetitive work cycle.

This is another example of the important role played by NOPAK Cylinders and Valves in actuating and controlling precision machine movements. Others are shown in the NOPAK Application Manual. Ask your NOPAK Representative to show you this helpful book.

Refer to Classified Section of your Telephone Directory for name of nearest NOPAK Representative.

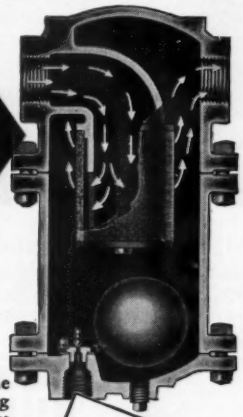
GALLAND-HENNING NOPAK DIVISION
2759 S. 31st STREET • MILWAUKEE 46, WISCONSIN

NOPAK
® VALVES AND CYLINDERS
DESIGNED for AIR and HYDRAULIC SERVICE

Circle 30A on reply card

A 8443-½H

NO MOISTURE OR DIRT GETS BY HERE



Johnson Self-Draining Compressed Air Separator.....

Like all Johnson Separators the new Type "SA" Self-Draining Separator combines the two most effective principles of removing moisture and dirt from compressed air:

1. Controlled expansion of air in separator precipitates most of the moisture.
2. A "thousand baffles" of coarse mesh repeatedly changes flow of direction to capture remaining foreign matter.

Johnson Separation Devices include Separators for Compressed Air or Steam. After coolers, oil absorbers.

Self-Draining—a simple but complete trap mechanism built right in, automatically drains separator whenever necessary.

WRITE FOR CATALOG

The Johnson Corporation
830 WOOD STREET THREE RIVERS, MICH.

Circle 31A on reply card

BUY BOTH BOOKS FOR $5.00

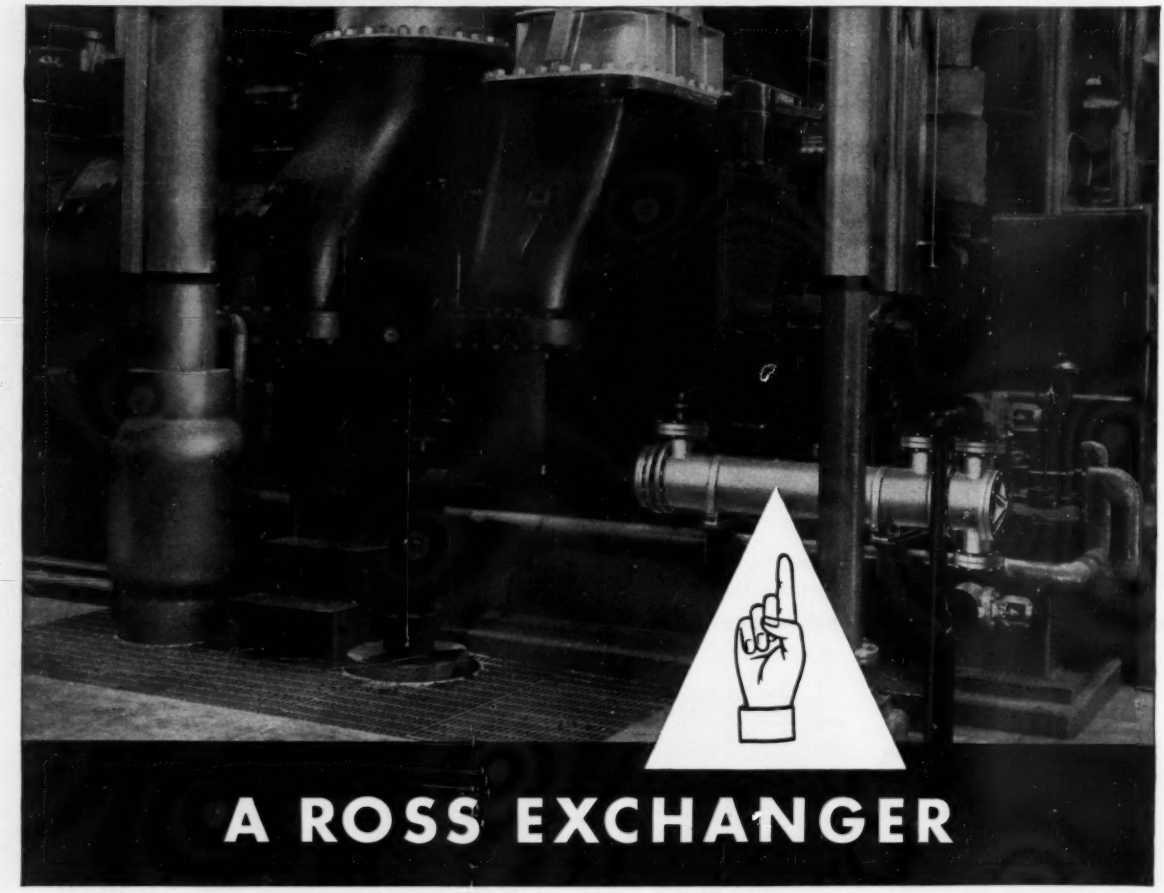
Price Individual Books	Per Copy
Compressed Air Data	$3.00
Cameron Hydraulic Data	3.00

COMPRESSED AIR MAGAZINE, 942 Morris Street, Phillipsburg, New Jersey.
Please send me:

- ☐ Compressed Air Data and Cameron Hydraulic Data..Both books for $5.00.
- ☐ Compressed Air Data.....$3.00
- ☐ Cameron Hydraulic Data.....$3.00
- ☐ Enclosed is (money order) (check) for $.....) ☐ Send books C.O.D. I understand that the books will be sent me postpaid, and that they may be returned within 10 days if not satisfactory.

Name .....
Company .....
Street No. .....
City .....State .....Country .....

For close control of lube oil temperature in this Ingersoll-Rand Turbo-Blower



Designed for wide range performance in gas booster service, this Ingersoll-Rand Turbo-Blower was installed by the Pacific Gas and Electric Company to meet increasing peak loads in the San Francisco area.

Rated at 30,000 cfm, the four-stage blower is driven by a 2,395 hp I-R Turbine at 4500 rpm. Controlling the lube oil temperature is a Ross Type CP Exchanger. Overheating is most dependably prevented.

"We never have trouble with Ross units . . . the fact that they are more or less standard on certain of our lines means they are entirely satisfactory," states Ingersoll-Rand.

Regularly selected for their top-rated thermal performance, Ross Exchangers are used extensively in the petroleum, gas and chemical industries on numerous types and makes of prime equipment: engines, compressors, speed increasers, centrifugal pumps, transformers and hydraulic equipment, to mention a few.

Assembled from mass produced parts and sub-assemblies to fully standardized, pre-engineered designs, Ross Type CP Exchangers are promptly available to meet most requirements. For detailed information, request Bulletin 2.1K1.

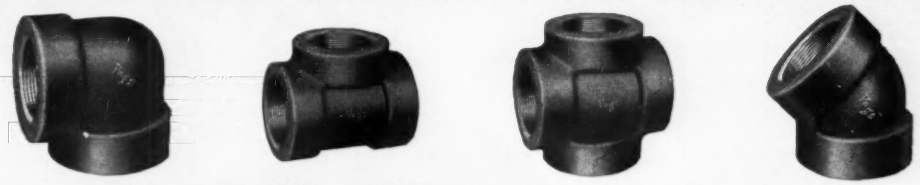
KEWANEE-ROSS CORPORATION
DIVISION OF AMERICAN RADIATOR & STANDARD SANITARY CORPORATION
1471 WEST AVENUE • BUFFALO 13, N. Y.
In Canada: Kewanee-Ross of Canada Limited, Toronto 5, Ont.

Serving home and industry: AMERICAN-STANDARD • AMERICAN BLOWER • CHURCH SEATS & WALL TILE • DETROIT CONTROLS • KEWANEE BOILERS • ROSS EXCHANGERS • SUNBEAM AIR CONDITIONERS

Circle 32A on reply card

STRENGTH

for Safety and Long-Time Service



For 2000, 3000 and 6000 pounds service — Sizes 1/8" to 6"

SCREW END TYPE

For schedules 40, 80 and 160 pipe — Sizes 1/8" to 4"

SOCKET WELD TYPE

Vogt Ells, Tees, Crosses, etc., are forged from carbon steel or various alloys to meet specific operating conditions. Catalog F-9 will aid you in their selection and proper application.

Shocks and stresses imposed by high pressures and high temperatures are taken in their stride because Vogt fittings are uniform in structure, fine grained, and free from porosity . . . the superior product of laboratory controlled materials and giant forging hammers and upsetters. These properties also give higher resistance to erosive and corrosive conditions, thereby adding to service life expectancy in steam plants, petroleum refineries, chemical plants and related industries.

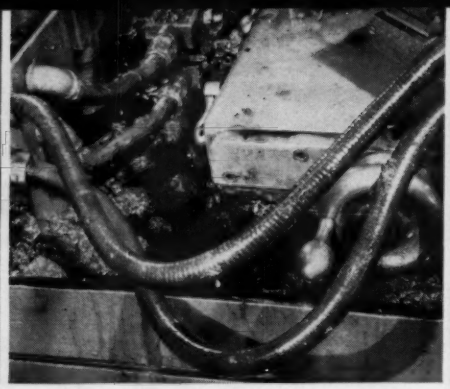
HENRY VOGT MACHINE CO., INC.
Louisville 10, Kentucky
BRANCH OFFICES: NEW YORK • PHILADELPHIA • CLEVELAND • CHICAGO • DALLAS

Vogt FOR BETTER FITTINGS

Vogt **DROP FORGED STEEL FITTINGS**

Circle 33A on reply card

Sealtite resists corrosive mixture of powdered calcium sulphate, magnesium oxide and magnesium chloride.

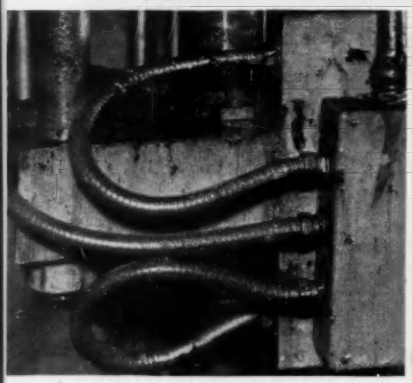


Sealtite protects grinder motor leads . . . flexes continuously under abrasive coat of metal dust, oil and coolant.

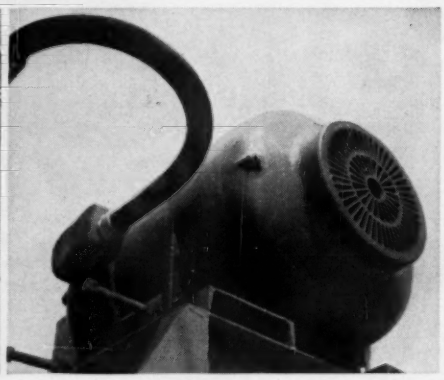
In paper mill's steamy air, Sealtite is covered with oil and wet pulp containing chlorine and caustic soda.

Give the dirtiest jobs to

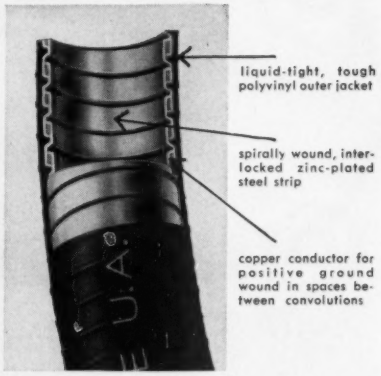
SEALTITE flexible, liquid-tight conduit



Sealtite makes tight bends on hydraulic press, keeps motor leads free from oil, grease and water.



Sealtite keeps weather out of leads to outdoor pump motor.


liquid-tight, tough polyvinyl outer jacket
spirally wound, interlocked zinc-plated steel strip
copper conductor for positive ground wound in spaces between convolutions
U.A.

Cutaway shows construction details of Sealtite Type UA.

Sealtite is made in two types. Specifications in table below. Type UA is approved by Underwriters' Laboratory for service in wet spots. Available in light gray as well as black.

Type EF† meets JIC standards. Extra flexible . . . ideal for machine tool applications. Standard stock colors: black, and machine tool light gray at no extra cost.

SEALTITE TYPE E. F.

Trade Size (In.)	INSIDE DIAMETER (Inches)		OUTSIDE DIAMETER (Inches)		Appr. Inside Bend Diam. (In.)	Est. Wgt. (Lbs. Per 100 Feet)	Feet Per Std. Coil
	Min.	Max.	Min.	Max.			
⅜	.485	.505	.690	.710	5	24.0	250
½	.620	.640	.820	.840	6	29.0	200
¾	.815	.835	1.030	1.050	9	38.5	200
1	1.030	1.055	1.290	1.315	10	68.0	100
1¼	1.370	1.395	1.630	1.655	13	86.0	100
1½	1.575	1.600	1.875	1.900	15	117.0	50
2	2.020	2.045	2.350	2.375	17	155.0	50
2½	2.480	2.505	2.850	2.875	20	198.0	—
3	3.070	3.095	3.470	3.500	27	282.0	—
4	4.000	4.050	4.465	4.500	34	414.5	—

SEALTITE TYPE U. A.

Trade Size (In.)	INSIDE DIAMETER (Inches)		OUTSIDE DIAMETER (Inches)		Appr. Inside Bend Diam. (In.)	Est. Wgt. (Lbs. Per 100 Feet)	Feet Per Std. Coil
	Min.	Max.	Min.	Max.			
⅜	.484	.504	.690	.710	8	30.0	200
½	.622	.642	.820	.840	10	36.6	200
¾	.820	.840	1.030	1.050	15	48.2	150
1	1.041	1.066	1.290	1.315	18	87.7	100
1¼	1.380	1.410	1.630	1.660	21	116.5	50

Sealtite* flexible, liquid-tight conduit gives wiring maximum protection against oil, grease, water, dirt, chemicals, corrosive atmospheres and weather. Nothing gets through its tough, polyvinyl outer covering. It stands up under continuous flexing . . . absorbs vibration, connects moving parts . . . connects misaligned outlets . . . prevents burn-outs. For long runs or short leads it's easy to install . . . saves the time it would take you to cut, bend and fit rigid conduit.

ELECTRICAL WHOLESALERS stock Sealtite in easy-to-handle coils. Buy it this way in long lengths . . . cut it on the job without waste. Your electrical wholesaler also stocks liquid-tight connectors. For more information write for Sealtite bulletins. Address *The American Brass Company, American Metal Hose Branch, Waterbury 20, Conn.*

*Trade Mark
†Pat. App. For

55162

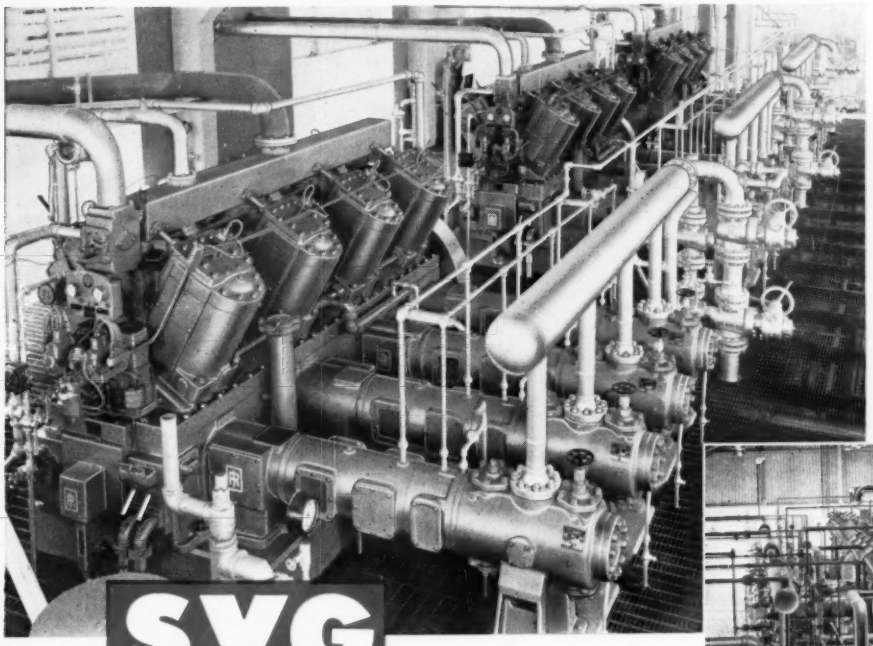
SEALTITE FLEXIBLE, LIQUID-TIGHT CONDUIT

AN **ANACONDA®** PRODUCT

Circle 34

in CATALYTIC REFORMING too,

Ingersoll-Rand gas-engine compressors offer important advantages



SVG
330 to 660 hp

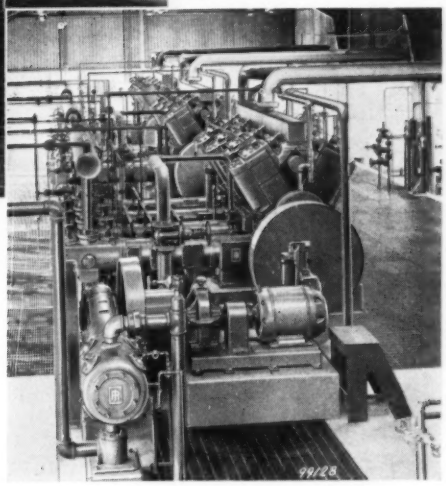
At Pontiac Refining Corp., Corpus Christi, Texas, these three Ingersoll-Rand SVG gas-engine-driven compressors recirculate 85.8% hydrogen gas for the U.O.P. Platforming Unit built by Procon, Inc. NL cylinders with graphitic carbon wearing and compression rings and double compartment distance pieces, provide full protection against oil contamination of the reforming catalyst. Each unit rated 440 hp, 450 psig intake, 610 psig discharge.

Compressors for catalytic reforming service are subject to wide variations in speed and load—and the compressed hydrogen gas must be kept entirely free from oil, to avoid contamination of the catalyst.

Both of these conditions are met to excellent advantage by Ingersoll-Rand SVG compressors. The inherent stability of the V-type *four-cycle engine* assures smooth, dependable power all the way from no load to full load, at anywhere from half speed to full rated rpm.

And I-R job-engineered compressor cylinders and valves contribute to trouble-free operation of the compressor end. Type NL non-lubricated compressor cylinders, pioneered and perfected by Ingersoll-Rand and double compartment distance pieces, prevent any trace of oil from getting into the gas stream.

Whatever the job, it will pay you to look into these basic advantages of the SVG compressor. Ask your I-R representative for the complete story. Or write for Bulletin 3128-A.



At Great Southern Chemical Company, Corpus Christi, Texas, these three I-R 440-hp SVG units are also serving a Procon installed U.O.P. Platformer, compressing 90% hydrogen from 190 to 370 psig. Here, too, I-R non-lubricated cylinders and distance pieces are used to keep oil out of the gas stream. Capacity and pressure are controlled by variable engine speed plus hand-operated inlet unloaders.

Ingersoll-Rand

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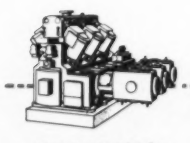
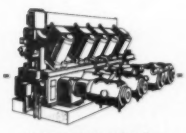
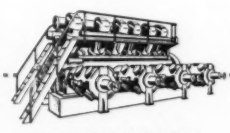


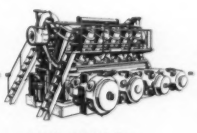
JVG, 110-220 hp



SVG, 330-600 hp



KVG, 880-1320 hp



KVS, 2000 hp

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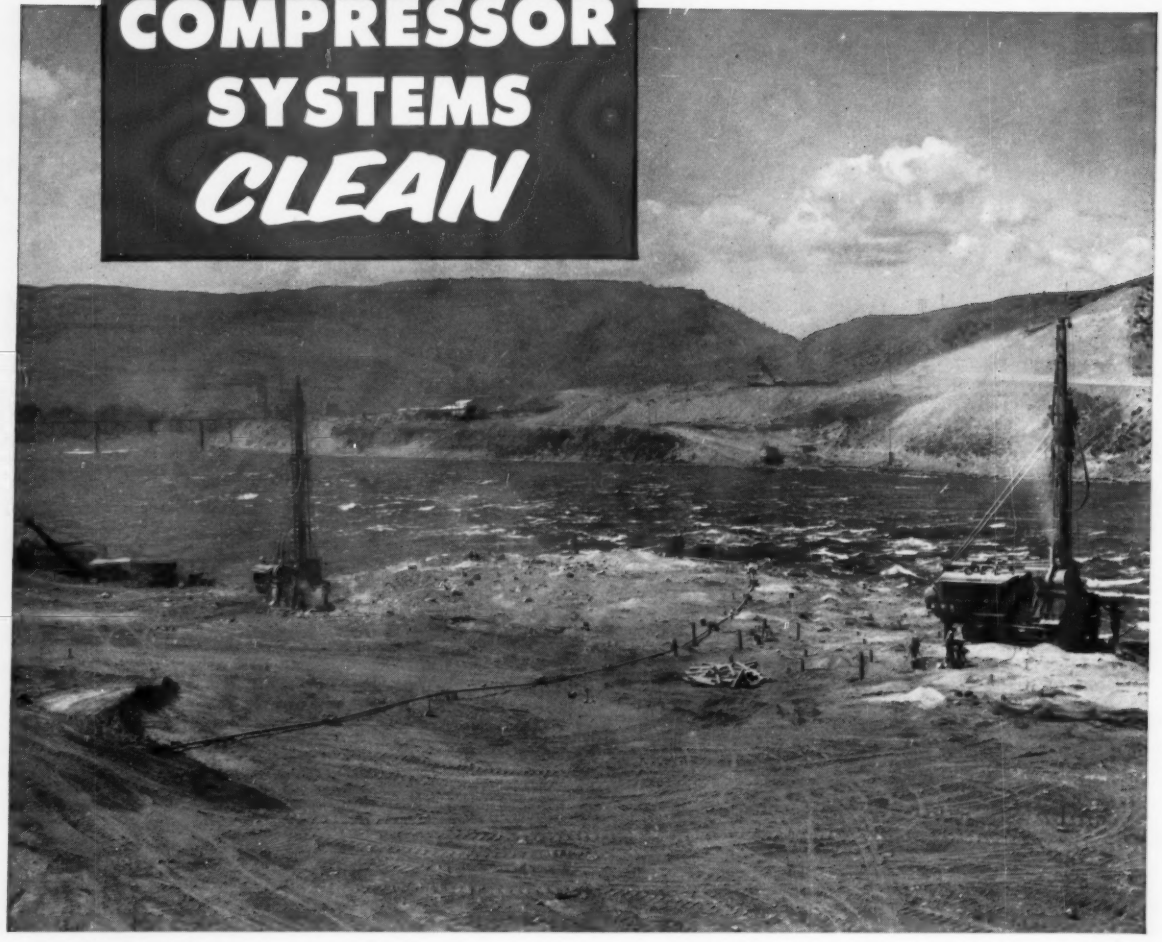

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